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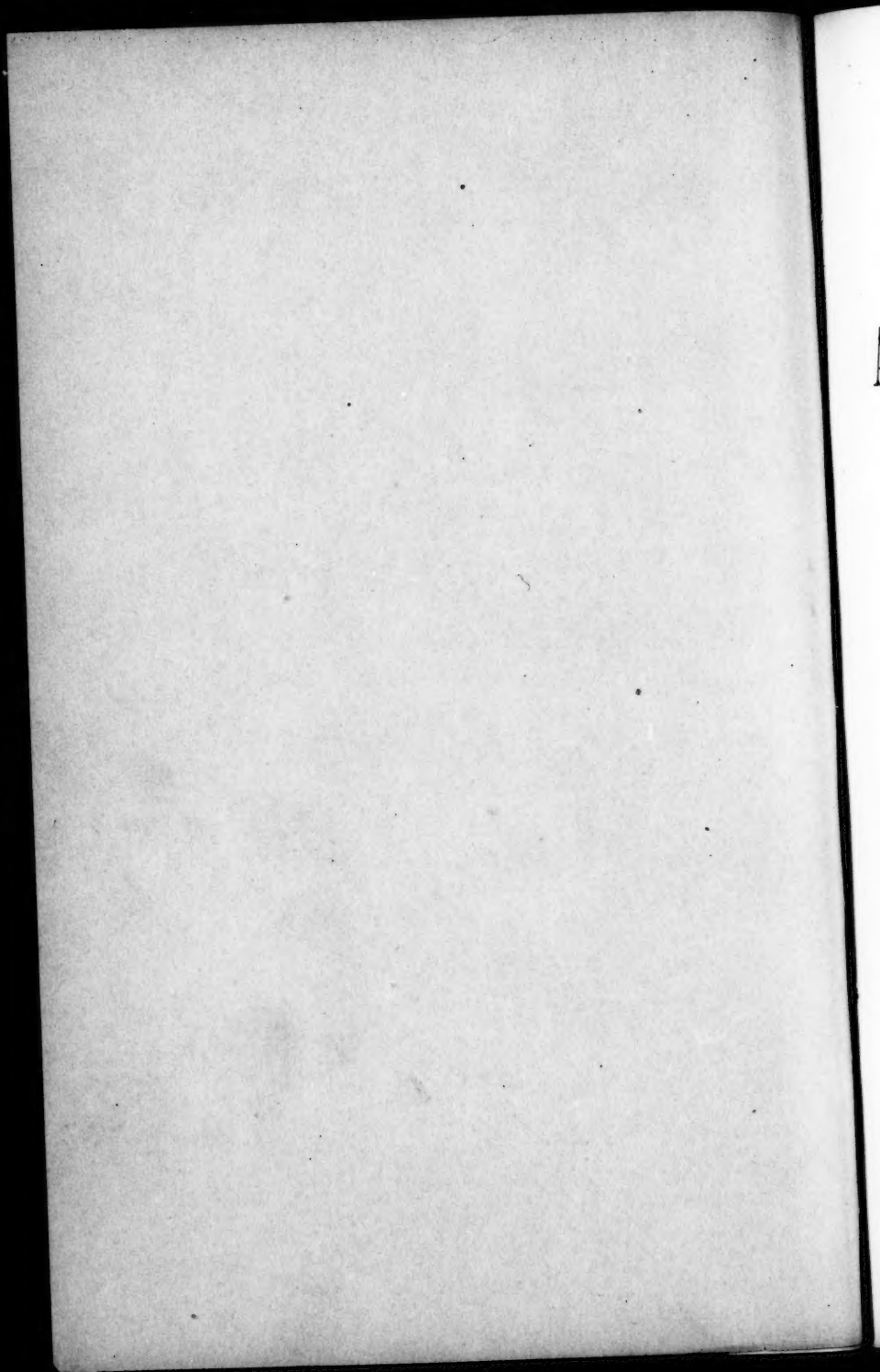
American

Fisheries Society

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1899

Vol. 28



PROCEEDINGS

OF THE

AMERICAN FISHERIES SOCIETY

TWENTY-EIGHTH ANNUAL MEETING

HELD AT THE

INTERNATIONAL HOTEL

NIAGARA FALLS, N. Y.

WEDNESDAY and THURSDAY, JUNE 28th and 29th, 1899

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MINUTES OF THE 28TH ANNUAL MEETING OF THE AMERICAN FISHERIES SOCIETY.

INTERNATIONAL HOTEL, NIAGARA FALLS, NEW YORK, JUNE 28 AND
29, 1899.

The meeting was called to order by President Peabody at ten o'clock a. m.

The following old and new members were in attendance at one or more of the sessions:

District of Columbia, George M. Bowers, W. de C. Ravenel; Kentucky, J. Hub Prather; Maryland, A. F. George; Michigan, J. B. Reighard, F. B. Dickerson, Frank N. Clark, J. L. Preston, Herschel Whitaker, Dr. J. C. Parker, Seymour Bower; New York, W. H. Bowman; Ohio, J. J. Stranahan, J. E. Gunckel; Oregon, S. W. Downing; Pennsylvania, J. A. Dale, B. L. Douredoure; Rhode Island, H. C. Bumpus, Henry T. Root, C. W. Willard, Wm. J. Morton, O. D. Roberts; Vermont, John W. Titcomb; Wisconsin, George W. Peabody.

During the meeting the following gentlemen were elected to membership in the Society:

Benton, W. H., Bullochville, Ga.
Bowers, Hon. George M., Washington, D. C.
Brewer, W. C., Cleveland, O.
Curtis, J. M., Cleveland, O.
Dinsmore, J. H., St. Johnsbury, Vt.
Downing, S. W., Stone, Oregon.
Filkins, B. G., Northville, Mich.
George, Hon. A. F., Swanton, Md.
Hughes, Frank L., Ashland, N. H.
Kerr, T. R., Pittsburg, Pa.
Kiel, W. M., Carolina, R. I.
Mancha, H. H., Northville, Mich.
Marsh, M. C., Washington, D. C.
Merrill, M. E., St. Johnsbury, Vt.
Miller, G. F., Put-in-Bay, O.
Miller, W. S., Gallion, O.
Moore, C. H., Detroit, Mich.
Morse, Grant M., Portland, Mich.

Morton, W. P., Providence, R. I.
Mussey, George D., Detroit, Mich.
Orr, W. J., Bay Port, Mich.
Prather, J. Hub, Lexington, Ky.
Roberts, A. D., Woonsocket, R. I.
Robinson, W. E., Mackinaw City, Mich.
Root, Henry T., Providence, R. I.
Smith, L. H., Algona, Iowa.
Southwick, J. M. K., Newport, R. I.
Starbuck, Alexander, Cincinnati, O.
Sterling, J. E., Crestfield, Md.
Stewart, A. T., Northville, Mich.
Thayer, W. W., Detroit, Mich.
Tawes, J. C., Crestfield, Md.
Tubbs, F. H., Neosho, Mo.
Walleth, W. H. Put-in-Bay, O.
Willard, C. W., Westerly, R. I.
Williams, J. A., St. Johnsbury, Vt.
Wilson, S. H., Cleveland, O.
Wires, S. P., Duluth, Minn.
Zalsman, Philip G., Paris, Mich.

Secretary Whitaker:

Mr. President and Members of the Society: I received a letter from the Treasurer of the Society something like a week ago saying that his family had been sick for about a year, that he hoped, however, to be present at this meeting. This morning, on my arrival here, I am in receipt of a letter stating that he is unable to come, and that he has forwarded by express his report to me here, at the hotel. It has not reached here yet, and it will become necessary for someone to be appointed to act temporarily in his stead. I move that Mr. Douredoure of Philadelphia be appointed to act as Treasurer pro tempore.

The motion was seconded and carried.

President Peabody: In calling the meeting of the American Fisheries Society to order the President has no report to make, other than to congratulate those present upon the large number here, in consideration of the fact that most of us come five or six hundred miles to this meeting which has no gifts or emoluments to offer. Those who come here come for the love of the purposes of the Association. The meeting is now open for the transaction of business.

Secretary Whitaker: Mr. President, it has been customary for this Society to meet in different places on the invitation of some city, which has usually provided for our entertainment. We are not so situated here, but we are at a place of exceeding interest, and I have no doubt the members will desire during their stay to take advantage of the opportunity to visit some of

the objects of interest about Niagara Falls. It is within the province of this Society to dictate the time of its sessions. Personally, there are places I should like to visit, and I have no doubt others would like to do the same. It might be well for us to fix our times of meeting so as to convenience the members and intersperse such visits with the business meetings. We are not absolutely restricted to two days attendance here. I suggest this, so that you may understand the situation and govern yourselves accordingly.

President Peabody: It might be proper to have a committee appointed to arrange the hours of the meeting and the extent of the session. If there is no objection, I will appoint Mr. Willard, Mr. Titcomb and Mr. Bower as such committee.

Mr. Bumpus: I move that the Chair appoint a committee of three to examine and report upon the names presented for membership.

The motion was duly seconded and was carried.

The President appointed as such committee Messrs. Dale, Bumpus and Gunckel.

President Peabody: The next thing in order will be the Secretary's report.

Secretary Whitaker:

Mr. President, and Members of the Society: The Secretary has no formal report to make for the year. The ordinary details connected with the office of the Secretary have been performed. The minutes of the meeting were gotten out and distributed to the members, I believe, within sixty days of the close of the meeting. While I am on this subject, I wish to make a motion that the minutes of the last meeting, as they appear in the printed record, be accepted and adopted as the report of the last meeting.

The motion was seconded and carried.

Secretary Whitaker: Continuing, I wish to say that at the last meeting there was a motion made that the Secretary be directed to communicate with the Governors of the different states, asking them to send representatives to the meeting at Niagara Falls. Something like two months ago, or perhaps a little less, I prepared such a formal address and sent it to the Governors of nearly all the states, and I also sent copies to other parties who I thought would be interested. The response to those circulars was very gratifying indeed. The Governor of Kentucky sent me something like twelve or fourteen names of men whom he had appointed to officially represent his state at this meeting. The Governor of New Mexico, the Governor of Idaho, and several other Governors did the same thing; and the evidence of the wisdom of passing that resolution is manifested here today in the increased attendance and in the num-

ber of new faces we see here. The American Fisheries Society is to be congratulated upon its reinforcement by these gentlemen, who have come such a long distance; and I am sure we all hope that they will experience benefit to the extent of the pleasure that we shall experience in associating with them. I have several letters of regret from members who are unable to attend.

The Secretary here read letters of regret from Professor Henry B. Ward, of the University of Nebraska; Hon. W. W. Barrett, Dakota; Mr. W. L. May, and Messrs. Huntington, Meehan and Birge.

Secretary Whitaker: I believe that this is all the report that I have to make at this time.

Mr. Gunckel: Mr. President, I believe it is customary for all officers to make a report, and I being an officer want to make such a report. I can not use the fine language these gentlemen use, because they are trout fishermen and understand how to get everything from nature that can be procured. I am only a common black bass fisherman. I have caught, I think, the largest black bass that was ever caught in Lake Erie, and my witness is Mr. Stranahan, a very distinguished gentleman. As you know, I am Corresponding Secretary, and have been for two years. During the last year I have had a great deal of correspondence with foreign members, with gentlemen greatly interested, in London and throughout the United States. I have had quite a number of letters making inquiries and letters from gentlemen desiring to become members. These I send to the Secretary, and when questions of a scientific nature are propounded to me I send those that I can not answer also to the Secretary. Anything easy about the catching of perch, and that sort of thing, I answer myself, but these scientific questions I turn over to the Secretary and request him to answer. I volunteer this report simply to show that I did something in the performance of my duties during the year.

Secretary Whitaker: I move that a committee of three upon the nomination of officers for the ensuing year be appointed by the chair.

Mr. Clark: I would support the motion of Mr. Whitaker in regard to the committee on nominations, if he will make it a committee of five.

Secretary Whitaker: I will accept the amendment.

The motion, as amended, prevailed, and the President stated he would announce the committee later on.

Mr. Gunckel: I move that a committee of three be appointed to select a place of meeting next year.

The motion was duly seconded.

President Peabody: Before that motion is put, it might be

proper to listen to invitations or suggestions that might serve as a guide to the committee in selecting the location.

Mr. Bower: I suggest that the committee give a hearing, and such suggestions and invitations be made at the hearing.

Mr. Bumpus: I move that what has just been said be interpreted as instructions to the committee. I second the motion with that understanding.

President Peabody: It is understood, then, that the committee will give a hearing.

The motion prevailed, and the President announced that the committee would be designated later.

Mr. de Ravenel: Mr. President, I would like to ask whether any of the State Fish Commissions here represented expect to make an exhibit at the Pan-American Exhibition to be held in Buffalo in 1901. I represent the United States Fish Commission there, and have recently attended a meeting of the Government Board in Buffalo, and we are arranging for a very interesting aquarium exhibit. We want to make it the best live fish exhibit that has been made in this country at any exhibition, not excepting the World's Fair, and if any State Commissions have appropriations for that purpose, or for any other purposes, as far as the exhibition of fish is concerned, I would like, in behalf of the Exposition people and the United States Fish Commission, to ask that they co-operate with us rather than put up an opposition show. This does not pertain strictly to the American Fisheries Society, but I thought it would be well to bring the question up and call it to the attention of any gentlemen who might be interested. I think if they propose to go into it that with the means now at our disposal we can put up an aquarium, and in fact pay all the expenses.

Some further discussion ensued in reference to the fishery exhibit at the Pan-American Exhibition and the Paris Exposition, after which the President announced as the committee upon the place of meeting Messrs. Titcomb, Gunckel and Dale; as the committee on nomination of officers, Messrs. Whitaker, Bumpus, George, Clark and de Ravenel.

On motion duly seconded the Convention adjourned until 2 p. m.

AFTERNOON SESSION.

President Peabody called the Convention to order at 2 o'clock, and called for the report of the committee on place of meeting.

Mr. Titcomb: Mr. Chairman, your committee has had several propositions and invitations, and Commissioner George of Maryland has suggested that we come to Mountain Lake Park, and has presented the advantages of the place. We understand that the President, representing the Wisconsin Commission, has offered inducements and invited us to Milwaukee; that Mr. Whitaker has presented letters from Governor Pingree and others, inviting us to Detroit or Lansing. Dr. Parker invites us to Grand Rapids, and the United States Fish Commission, represented by Dr. Bumpus, invites us to Woods Hole. We have canvassed the different places mentioned, and we think Woods Hole will be the best place to meet, for several reasons. It will give us an opportunity to visit the hatchery of the United States Fish Commission, where they are propagating marine fishes; there is a biological station where scientific work is going on, and there are many professional and scientific men who would naturally join the society if we meet at that place. I am well aware that the Commissioner, in his generous heartedness, has great plans of hospitality for us and will present all facilities of the commission in the way of boats, etc., so that we can get around to see the work that is going on there. In view of all the circumstances, your committee respectfully recommend that the next meeting be held at Woods Hole some time in July. The second week has been proposed, and that seems to be a convenient time, especially to superintendents of stations, as the fiscal year ends the 30th of June and all have to prepare extensive reports.

Mr. Willard: I move that the recommendations of the committee be adopted.

Mr. Clark: Mr. Chairman, I would submit the suggestion that possibly voting on this subject ought to be laid over until after the election of new members, so that they may have an opportunity to vote.

President Peabody: If there are no objections, then, we will first have the report of the committee on membership regarding the names presented.

Secretary Whitaker: I move that the gentlemen whose names have been presented be elected to membership.

The motion was duly seconded and was unanimously carried.

President Peabody: The question is now on the adoption of the report of the committee on location for next year.

Mr. Clark: Mr. Chairman, I am heartily in accord with the views of those who have made this report, but I can not let it pass without calling to the minds of the members the partial promise we gave our friends from Wisconsin last year at Omaha. They were very much in favor of our coming there this year, and the members who were in attendance gave them

a partial promise that we would endeavor to have the meeting there this year. I, with the rest, gave that promise. Of course, I would like to go to Woods Hole, but I wanted to call the members' attention to this fact.

President Peabody: That is very generous and considerate, but I will answer for the Wisconsin delegation that we will waive our rights in this matter. I think that we would all like to go to the Atlantic.

The President put the question upon the motion as made, and the same was duly carried.

President Peabody: Professor Bumpus has prepared a paper and has his material, which is perishable, for an object lesson, and we have put him first on the list for that reason.

METHODS AND RESULTS OF SCIENTIFIC WORK AT WOODS HOLE.

BY PROFESSOR HERMON C. BUMPUS.

In this paper it will be our purpose to describe only those methods which have been more recently adopted at the marine laboratory of the United States Fish Commission, and to note only those results of scientific work which have a distinctly economic bearing.

It will be remembered that in 1884 Professor Baird saw the completion of the station, the largest, and in many ways the most thoroughly equipped, plant for the observation of marine life in the world. During the summers of 1884-6 the entire department was transferred from Washington to Woods Hole. The rooms in the Residence were filled with executive officers, men of science, and clerical assistants; the laboratories were occupied by such investigators as Professor A. E. Verrill, Sidney I. Smith and W. S. Faxon; and the entire fleet of the Commission was busy in carrying on those lines of exploration which made the work of the United States Fish Commission the pattern for other nations to follow. But as the laboratory at Penikese profited by the directorship of Louis Agassiz for only one season the station at Woods Hole enjoyed the directorship of its founder only a brief period. During the years that immediately followed the death of Professor Baird, the station gave less and less attention to scientific work, until in 1897 the laboratories were actually closed. During the period of waning scientific activity, the station passed through all the stages of material decay. Not only were the laboratories deserted and the scientific equipment destroyed, but the buildings became unoccupied, the vessels of the commission seldom made their appearance, and the wharves and basins reached a stage of disintegration wherein they were picturesque but of little practical value. In the meantime the work of fish-hatching had continued, but only along the old lines and in the perfunctory way that prevails for those who take no vital interest in their work.

I believe that the history of the Woods Hole Station during its dark ages of scientific inactivity will be the history of every

station and sub-station that attempts to confine its energies to the merely mechanical work of hatching fish. Close up your drafting room, and your machinist becomes a blacksmith; do away with your schools of design, and the standard of even your so-called practical builder is immediately lowered. More progress has been made in practical medicine during the past twenty-five years than during the previous twenty-five centuries. Who shall say that the progress is not the direct result of laboratory activity and the application of scientific method? The scientific and practical work of a fisheries station cannot be divorced.

On his appointment, the present Commissioner, the Honorable George M. Bowers, recognizing the intimate relation that exists between science and practice, reopened the laboratory which Professor Baird had founded, made generous appropriations for the purchase of scientific apparatus, attached suitable vessels to the station, and invited the naturalists of the country to take up their abode at Woods Hole, and enjoy its privileges. Viewed only in the light of expediency, this action brought to the Commissioner the support of men of science throughout the country. With this support he was enabled to induce Congress to appropriate funds sufficient to put the neglected station in repair, to purchase a new vessel, to provide extensive apparatus for the capture of fish, to more completely equip the laboratories, enlarge the library, increase the staff, and, I think I am justified in adding, to secure the largest appropriation for fish hatching that had ever been made. At the present writing five steam vessels, large and small, are busily engaged at Woods Hole, and fully forty men of science have taken places in the laboratories. Of this willing corps of workers, many are busied with problems of direct interest to the Commission.

For years the fish retained in the aquaria at the station have suffered with what has been known as the gas-bubble disease. The cause of this disease remained entirely unknown, and efforts toward its prevention were ineffectual, until the problem was taken up by a bacteriologist, not in the employ of the commission, but merely enjoying the opportunities of the station. Professor F. P. Gorham found that the disease was not the result of bacterial invasion, but that it resulted from the reduction in pressure on the natural gases of the body, which took place when fish habituated to a life in deeper water were transferred to the shallow water of the aquaria.

The large fish-traps operated by the station have furnished a sufficient amount of material to enable Professor Edwin Linton of Washington and Jefferson College to pursue his investigations on fish parasites, and his contributions have materially increased our knowledge of parasitology. It is of

prime importance that the fish culturist should be acquainted with the entozoa which may invade the hatchery, but it is still more important that the public should be acquainted with the life-history of animals that may also infect man.

The sea traps, just mentioned, have also provided Professor Ralph W. Tower with the abundant material necessary for his observations on the causes of decay in fish, and methods of arresting decay without the use of ice. Professor Tower's work has been carried on under the direction of the Rhode Island Commission of Inland Fisheries. He has shown conclusively that fish carefully handled will keep absolutely fresh for twenty-four hours, under the most trying climatic conditions without the use of ice. When we consider the large sums of money that the commercial fisherman is obliged to pay for ice, and the heavy charge for expressage on the same, the importance of these investigations becomes more evident.

Buzzards Bay and Narragansett Bay are tracts of water of about equal area, lying side by side along the southern coast of New England, and having very similar physical characters. The Commissioners of Massachusetts have seen fit to prohibit the use of fish-traps and weirs in Buzzards Bay, while the Commissioners of Rhode Island allow free fishing privileges to the inhabitants of the state. The launches of the station at Woods Hole have been used to secure data relative to fisheries conditions prevailing in the two bodies of water, and while several years may be needed to definitely settle the matter, it must be admitted that line fishermen are quite as successful in Narragansett Bay as they are in Buzzards Bay, for all that they compete with one hundred and fourteen traps in the one locality and none in the other.

The Woods Hole Laboratory has furnished Professor C. J. Herrick of Dennison University with material that has enabled him to trace with accuracy the origin and distribution of the cranial nerves, and Dr. Ira van Gieson of the New York Pathological Institute has been provided with material of use in elucidating certain problems relating to the structure and functions of nerve cells. While these neurological researches have no bearing upon fish culture, and only a remote bearing upon the scientific problems ordinarily studied at the station, it is a narrow view that would limit the scope of research to that only which deals with fish for food and fish for sport. If the wealth of marine life that is brought to a laboratory can be of use in the solution of biological problems, and if the study thereupon does not interfere with the immediately practical work of the station, it should be encouraged, for the efficiency of the Commission is thereby increased.

Last fall the water of Narragansett Bay suddenly turned a

deep red, and emitted an almost unbearable odor. Fish were killed, even eels sought the shore, and dead shrimp were washed up in windrows. The need of a specialist was keenly felt, for the cause of the bloody water was quite unknown. With the advice of my colleagues on the Rhode Island Commission, Dr. A. D. Mead, a man specially trained in microscopical work, was employed to investigate the matter. A species of *Peridinium* was found to have caused the mischief. We were advised that the trouble would probably be only temporary, and manufacturers who are obliged to pour waste dyeing material into the waters of the bay were exonerated. Now comes the further economic bearing.

Soon after the enemy was really known, word was received at Washington that the oysters in the Chesapeake were turning a deep red color, and cautious dealers were disinclined to buy. It was an easy matter to show that the red oyster had been feeding upon *Peridinium*, that the flesh was not impaired thereby, and that the discoloration would in all probability last for only a brief period.

It will be remembered that in 1880 and 1881 Professor Baird was greatly interested in the development of a tilefish industry, the tile having been discovered in great numbers off the shore of southern New England, but a few hours' sail from the markets of New York, Boston and Newport. In the spring of 1882 these fish were practically exterminated, their dead bodies covered hundreds of square miles of the ocean surface, and subsequent efforts to find the fish resulted only in the discovery of scattered individuals. Last summer a body of scientific men sailed from Woods Hole in the schooner *Grampus*, for the purpose of again testing the tilefish ground. The very first haul of the trawl brought several beautiful specimens to the surface. Thus encouraged, the *Grampus* continued her work through the summer, capturing hundreds of the fish, and never once setting the trawls in vain. The tile is an excellent food fish, rivaling the halibut in flavor and keeping qualities, and the establishment of a tilefish industry will more than pay for what the Commission may have expended for scientific work.

The oyster culturists of the north are sadly persecuted by the starfish. The pest appears in countless numbers, and destroys thousands of dollars' worth of property. That the wholesale seining of the menhaden has a direct bearing upon the oyster industry was never suspected until the researches of Professor Mead, carried on in Narragansett Bay and at Woods Hole, proved beyond peradventure that the young of the starfish, at times so abundant that they actually color the water, are the natural food of the menhaden, the schools of

which form a living skimming net, often a mile in breadth. The menhaden, as is well-known are in turn captured by the steam sailing vessels in countless numbers. I think it is perfectly justifiable to ascribe the rapid increase in the number of starfish to the rapid decrease in the number of their natural enemies, through the destructive methods of steam seining.

For several years the clam industry of the north has rapidly deteriorated. A survey of the literature reveals a deplorable condition of ignorance respecting the breeding habits of the clam, its rate of growth, time of sexual maturity, food, enemies, etc. Professor J. L. Kellogg was engaged to investigate the entire question. He worked at Woods Hole and in Narragansett Bay, and reported to the Rhode Island Commission. The results of his labors show:

1. That there is an abundance of young clams. During July the shores are literally covered.
2. These young clams are destroyed by young stars, which appear on the shores at about the same time that the clams appear.
3. The young clams take kindly to artificial rearing.
4. The rate of growth is rapid.

With these data the Rhode Island Commission has seriously undertaken artificial clam culture, and the experiments thus far made have fully warranted their expenditures. When one considers that an acre of clam land would probably produce 174,240 clams, which at six cents each (the price at which they were selling in New York last March) would yield \$10,454, the relative productivity of clam beds in New England and orange groves in Florida becomes impressive.

Perhaps no industry is more in need of intelligent treatment at the present time than the lobster industry. During the past three or four years lobsters have become increasingly infrequent, and unless something is done to change the curve of destruction or elevate the curve of production, a few years will see the animal exterminated.

The eggs stripped from the female readily develop and hatch in McDonald jars, but the young quickly perish under the unnatural environmental conditions of the hatchery. The mere planting in the ocean of the young during their free-swimming stages is of questionable value, although it is to be commended so long as egg lobsters are sent to market or stripped by the fishermen to evade the payment of justifiable fines.

If the young could be artificially brooded until they reach the fourth stage, when they are in the habit and structure more like the adult, they would be more likely to flourish after their liberation from the hatchery, and the industry might then become rehabilitated. During the present season we have

found a food that the young readily devour, we have designed enclosures within which they seem to flourish, and we have a larger number of young in advanced stages of development than ever before; but the problem is still unsolved, although I have no doubt that continued investigation will finally result in the discovery of a practical method of lobster culture.

In this report I have briefly outlined some of the results of our scientific work for a single year, and I have endeavored to indicate certain lines for its further development. Those who have attempted similar work know how many failures await the investigator, how reluctantly nature reveals her secrets, and how difficult it is to secure enthusiastic assistants, but in compensation how pleasurable is the sensation when one has really overcome a difficulty and is then ready to proceed to the next point of obstinacy.

DISCUSSION ON PAPER OF PROFESSOR BUMPUS.

Mr. Ravenel: I would like to say to Dr. Bumpus, in reference to the lobster question, that the Commissioner, on recommendation of Dr. Smith, who is in charge of the scientific work of the commission, thought that he had arranged this spring for the erection of a large pond to carry three or four million lobsters to the fourth stage, or, in fact, as far as possible; but the point selected proved unsatisfactory, the expense involved in fitting it up was greater than had been anticipated, it was inaccessible, and we are obliged to abandon the plan this spring. It is the intention of the Commissioner that a suitable point be found this summer, and that the work shall be carried to its logical conclusion next year. I desire, also, as one deeply interested in fish culture, to endorse all that Dr. Bumpus has said on the subject of scientific work in connection with fish culture. Without it we are absolutely powerless. We all know that stations are swept out of existence by disease today that the fish culturist has so far been unable to combat, nothing being written on the subject, and we have to look to the original investigator to solve those problems for us.

Mr. Titcomb: It is the custom, I believe, to ask questions after these papers are read. I did not quite gather what the food is that you fed the lobsters, if you stated it in the paper.

Mr. Bumpus: I did not state. We have spent considerable time in finding suitable food. Of course the young lobsters are pelagic; that is, it is natural for them to swim about in the ocean, and they are carried along by the current and pick up small organisms. We have tried to feed them with the

skimmings we have taken from the surface, but in the laboratory up to the present time they have not done very well with that food. I think we have probably tried a hundred or more different things, but the digestive gland of a full grown lobster is made up of a number of little threads like fingers if you look at it under a microscope; and if you take this digestive gland and break it up into small pieces—we first shake it in a glass till it is shaken apart—those little morsels are just the right size for a little lobster's mouth; but the air that gets in when you shake the digestive gland, or the liver, as it is called, makes the pieces so light that they tend to float on the surface and a young lobster will not take food from the surface; he will not ordinarily take food from the bottom; it is the food that is sinking down through the water, slowly, that excites his appetite; but if this liver is put onto a board and then a knife is taken and you cut it up into microscopic pieces and are careful to rinse that off, fill a flask and allow it to settle and pour off the supernatant fluid, and then wash again, so that you are not throwing wholly organic matter into the water you can take a little pipette full and squirt a little into these jars that hold the young lobster, and in about an hour you will notice a little yellow ball on the interior of each one, that means that its little stomach is just as full of that lobster liver as it will hold, and I assure you that those young lobsters are immediately to be distinguished from those lobsters which have been injured in the hatching process, or which, for some reason or other do not eat, and will undoubtedly die. But by far the larger number of lobsters will take the food, and the color of the jar as it stands on the table is very different from the color of the jar that contains young lobsters that have not fed. There are probably two or three thousand in this jar.

A Member: What is the form of this fourth condition that you speak of?

Mr. Bumpus: The fourth stage is very different from the stage that immediately precedes it. You would not take them for lobsters at all. The first three stages are more shrimp-like, and they have external gills that make the interior of the body look very fuzzy, or like chenille, as they move through the water. The rapidity of growth and the molting depend upon temperature and food. The experiments which we have made, and which I did not allude to in my paper, convince me that we have never given aquatic animals, marine animals, certainly, credit for growing one-half as rapidly as they will grow under favorable conditions, and with an abundance of food. There are many marine organisms that you can feed and notice an increase in size on the following day.

Mr. Titcomb: There is a red one here. Is that the color it assumes when it is dying?

Mr. Bumpus: There is a little difference in the color of all the young lobsters; they are red and green. The dead lobsters generally turn red, but very frequently you will have lobsters that live for a long time and are red.

President Peabody: Any further questions?

Mr. Stranahan: If these young lobsters are fed with an abundance of food, you think they undoubtedly get through these various stages much quicker?

Mr. Bumpus: I do; yes, sir.

Mr. Stranahan: The fresh water lobster can be forced to shed in about a week by giving it an abundance of food.

Mr. Bumpus: I am glad to know that.

Mr. Stranahan: I should presume that would likely be true also with these young salt water lobsters.

Mr. Bumpus: We have kept the young star fish to show how rapidly marine animals will grow; we have kept them so that they were less than the size of a head of a pin for some weeks, showing absolutely no increase, although they belonged to the same brood as others which reached a greater length; brother and sister, but one had been well fed and the other had not.

Mr. Bower: How does the hatching percentage compare with the hatching percentage under a strictly natural environment?

Mr. Bumpus: I think it is absolutely impossible to answer that question. How can one tell the number of eggs that hatch from the forty thousand that the female may start out with in July this year and which she carries around with her until next spring under natural conditions? You can not follow the lobster all that time and I do not know what the loss is. They can not be counted. I do not want to avoid your question, but I do not see how you can get data to determine.

Mr. Bower: I did not know but you could tell approximately.

Mr. Bumpus: I think if you could brood the lobsters in the hatchery until they reach this stage when they really are old enough to look out for themselves, I think you would be improving on nature very materially. I think if we get ten per cent of the young and raise them to this stage and put them in the waters along in the east, that in a very few years you would notice a striking difference in the number of lobsters captured.

Mr. Bowers: Did you determine how long the star fish is in a free swimming condition?

Mr. Bumpus: Yes, I think about two weeks—more or less.

Mr. Bowers: Does the lobster ever naturally propagate in ponds or inlets from the sea, or has it altogether to be done in the deep sea?

Mr. Bumpus: I think that wherever you find lobsters you will find lobsters breeding.

Mr. Bowers: I was told last week by a fisherman on a very small pond, that he was positive lobsters deposited their eggs right in the pond, and that they hatched and remained right there.

Mr. Bumpus: The lobster does not deposit the eggs except upon herself. They are attached to the hairs upon the lower part of the abdomen and carried around by her and if those eggs drop off they must unquestionably perish. The female lobster keeps the water lapping back and forth all the time which keeps the eggs aerated.

Mr. Bowers: Do you think it is possible that in this small pond less than a mile long, perhaps half a mile wide, with an inlet from the sea, that lobsters will hatch and propagate there and not leave till they mature?

Mr. Bumpus: I think it is possible they might remain there, but I think it is probable that they would not, for this reason: this spring I had a little pond cleared out at some expense and in that pond we provided a screen, so that we could allow the tide to rush in at a certain time and then slowly run out so that there would not be a strong current—and I found that the young lobsters had a tendency to follow the current. It was practically impossible to keep them in. We had several thousand in this little pond; in a couple of days we could not find any except a few dead ones, and the opening from the pond is very small, still those little lobsters would escape. I know they did because I had a trap outside the pond and caught them.

Mr. Bowers: Is the bottom of this pond all sand?

Mr. Bumpus: It was pretty clean gravel because we made it so.

Mr. Bowers: The pond I refer to abounded in ledges.

President Peabody: Any further discussion of this paper? If not Mr. F. N. Clark, Superintendent of the United States Fish Commission, of Northville, Michigan, will read his paper.

WHAT IS PROTECTION TO FOOD FISHES?

BY FRANK N. CLARK.

The importance of protection to fishes as a source of food supply, and a remunerative outlet for labor, cannot well be overestimated.

The necessity of adopting a proper and effective plan to increase and maintain our most valuable food varieties, is unquestioned, but the false impressions that prevail in the minds of many of our legislators, and the diversity of opinion among public men who are instrumental in the passage of unwise laws, make the work of the fish culturist doubly difficult. The prime object of all Fish Commissions, both State and National, is the perpetuity of fish life which contributes so materially to the welfare of mankind. I am today more impressed with the magnitude and importance of our fisheries than ever before, and the more deeply I study into the question, the more keenly is aroused my appreciation as to the real merit of fish cultural work.

Upon the success of its industries depends the prosperity of a Nation, and while the fishing industry, of itself, is a most important one, its close relation to other industries, and their partial dependence upon its success, is of momentous consideration. Our fisheries are a great source of wealth, giving employment to a vast number of our people, and furnishing the most wholesome nutritious meats for our population of 76,000,000. It is certainly good policy for the people to protect and develop this one of their great sources of affluence.

We are all familiar with the fact that the causes destroying the spawn or fry in their natural beds are increasing, while the demand for fish food in the extended markets is increasing, so improved methods and protected propagation have become not only a National duty, but also an imperative necessity. In connection with the work which we represent, according to my judgment, the most vital question of all is the question of protection. When the question of protection, as applied to all the different varieties, is definitely and accurately settled, in every particular instance, the efficacy of fish

culture will have been unanimously accepted, and will have reached a degree of perfection beyond our wildest dreams. And, although, a vast amount of good has been accomplished in behalf of the fisheries by the protection and assistance furnished by our different Fish Commissions, the hearty co-operation of law with fish cultural work is absolutely necessary to complete and perfect the science and art of fish culture. The word "protection" is often a misnomer, and on account of the euphony it carries, and the nutritive and beneficent qualities which it naturally suggests, many laws or methods under this head are passed, relating to our fisheries, and are frequently more oppressive than protective. If laws are so stringent as to prevent fishing for any great length of time during the year, this kind of legislation simply keeps the fish from our nets, our markets, and our tables, and is not protection at all. The object of true protection is to increase and maintain the supply to such an extent that very few laws will be necessary to assist nature and protected propagation to establish an equilibrium, without prohibiting the capture of mature specimens for human use, and thus obviate the imposition of many hardships, and the infringement upon the rights of those whose destined vocation it is to fish for a livelihood, by the retention of valuable food products in the waters, thus, under the shield of the law depriving the people of food which our Creator has so abundantly provided, and which with proper care and husbandry will, in all probability, supply any future demand.

Instead of maintaining the fertility of our soil only to its present productive power, there will come a time when conditions will necessitate that one acre of land must yield ten times, or twenty times, (as the case may be) as much as it does now. Imagine how inadequate would have been the crude facilities of olden times to meet the requirements of our present population! There must be a corresponding improvement upon the methods now employed, with the future increase of population, or their demands can never be supplied. If our population doubles every thirty-three years in the future, as it has in the past, the time is fast approaching when this country will become very densely inhabited, and the same is true of the rest of the earth. At this rate of increase, in only 132 years from now, we shall number, in round numbers, 1,200 million souls—and this is not far in the future—less than four generations of only one-third of a century each, when the population of this United States will be equal to about three-fourths of the present inhabitants of the globe. Pause for a moment and think how insufficient would prove our present stock of fish life to supply the needs of such a population!

And it is sure to come, if the wheels of time continue to move on and the earth is not destroyed.

We shall not be here in person, but we shall be represented by our posterity. The improved methods of preserving fish by cold storage, canning, etc., and the constantly increasing facilities for fish distribution, with increased demand, should stimulate research for improved methods of protection and propagation, and we should and can prepare the way for making the waters furnish the larger supply of meat foods for future emergencies. It has been claimed that nature has made ample and abundant provision for the great waste and loss of eggs which are cast by the improvident female in such reckless profusion and the destruction of fry, by the fecundity of the fish, but a more reasonable, liberal, and rational view to take of the matter is that nature has thus bountifully provided for the constant growth of the human family, who are given dominion over the fishes.

Three-fourths of the earth's surface being water, naturally suggests to my mind that at some future time, the dense population of the globe will necessitate mankind's dependence, to a great extent, upon the fish life of the rivers, lakes and sea, for his support, and it is a duty that we owe succeeding generations that we look that far into the future, when all available land will be required for the cultivation of cereals and fruits, and the non-support of fish life would mean famine. There is hardly any limit to the extent of the supply that our waters are capable of furnishing, with proper care, management, and protection. The system now in vogue is yet almost in its infancy and of comparatively recent trial and application. Who knows but what this great reproductive power possessed by food fishes may have been a provision of nature, to meet the requirements of such a populous condition of the earth which will necessarily prevail, if the forces of nature continue to act in the future as they have in the past, and the progress is not arrested by Divine interference?

When we become as densely populated as China, then we must do as the Chinese do (only with improved and better methods); that is, draw most of our meat from the water.

The Chinese have for a long time bestowed a great deal of attention to fish culture. With them it is a branch of economy. From the extent of their water territory and the enormous quantities of fish that can be cultivated, fish are very cheap, and form not only a most important article of their diet, but also of their National wealth.

Protection to successive generations of fish must necessarily include successful reproduction, and a proper method of protection cannot be decided upon without an accurate knowledge

of the characteristics of the fish under consideration. What constitutes protection to one kind of fish may be decidedly detrimental to another. But, this truth some of our law makers do not seem to realize, and indiscriminately pass laws practically similar for different fishes whose habits are as far remote as the nature of man resembles that of some of the lower animals. For instance, the class of protection which would insure the perpetuity of the lake trout and whitefish would be sure extermination to the black bass and to members of the Siluridae family which are bedguarders. The majority of our laws, however, discourage fish cultural operations. Note the imposition and insured waste of a closed season for lake trout and whitefish during their spawning period, making it difficult for the Commissions to procure the ova, and consider the heedless destruction of millions of useful germs which die in the unripe fish taken just before the spawning season. If they are to be protected at all, it should be during the month or months when the largest lifts of unripe fish are made. The laws for the so-called protection of the black bass are equally inconsistent, allowing the fish to be taken from its bed while furnishing such protection to the eggs or fry as nature and instinct have provided as indispensable to the future development of its brood or progeny. Such laws are not "protection to food fishes." With proper legal support, protected propagation is an invention designed to counter-balance the drain upon our stock of food fishes and to sow while man reaps.

Wise fish cultural operations, supported by co-operative law, are necessary for the future maintenance of our fisheries. The harmonious blending of these two is "protection to food fishes."

Statistics seem to indicate a marked increase in the annual catch of some of our most important food fishes the past few years, and I am persuaded to believe that these gratifying results are due more especially to protected propagation than to protective legislation—restricting or regulating the fishing—and that, so far, protective laws have been very ineffectual in restoring and maintaining our stock of food fishes, and that nature, when unassisted and not protected by man, could never establish an equilibrium or begin to counter-balance the drain imposed by our commercial fishermen, even with the accurate enforcement of twice our present number of stringent so-called protective measures. And, to spend large sums of money to prevent the people from fishing is in direct opposition to the purpose for which all Fish Commissions were established, and it is an injustice and a hardship to thousands of fishermen, who with their families, are dependent upon our fisheries for a living; so the kind of protection most humane to the fishermen

and most advantageous to the whole people is that which will encourage and develop the industry, instead of closing it, and instead of taxing the people to raise funds to enforce laws depriving thousands of honest men of their occupation, bringing destitution into their homes, and keeping the food from the general public, why not appropriate that money to the establishment of the industry, thus increasing our natural resources and adding materially to our public wealth? The water in the lakes, rivers, and sea belongs to the whole people, and it is the duty of the age that steps should be taken to maintain and develop our fisheries which are now holding their own, and to re-establish those which are now on the decline.

Prudence requires that we should meet the foes and obviate the dangers which threaten our food fishes, by turning all our philosophy, science and art into practical investigation. There are men here in our midst who have added some very valuable discoveries to fish cultural work, and have materially improved upon methods formerly employed which were learned from previous experimenters, and so there will be others who will come on after us, and taking up the work where we drop it, they will substitute in place of our very imperfect methods, some mode of protection which, as the necessity will demand, must insure better results. It is not my desire to present to you any startling facts with which you are not familiar, but I am impressed with the importance of protection, and instead of trying to throw any light on the subject, I am endeavoring to seek information by arousing a discussion on the question, and thus be benefited, myself, and stimulated to renewed thought, and perhaps, indirectly, be the means of doing some good, by suggesting that at our next meeting some of our members (or all of them if they feel so disposed), debate the question of protection more particularly with reference to laws best adapted and required for the success of their particular line of work.

In this way, we could all be benefited. It was my intention at first to compare laws, making use of statistics, by reviewing the results following the various changes in so-called protective legal measures regulating our fisheries, and after procuring a number of old laws, and deducing some comparisons and results, I concluded that the subject is entirely too lengthy and too comprehensive to be taken up in such a light and discussed at this meeting. To corroborate my views as to how ineffectual are the many laws relating to our fisheries, I have taken the time to communicate with some of the chief officials of the different State Fish Commissions and with interested private parties who have repeatedly made applications to have certain "fished out" streams restocked, and I find them almost unani-

mous in their opinion that where an increase has been noticed, it has resulted almost entirely from plants made, and cannot be attributed to stringent legal measures. The most marked results in the line of very noteworthy success attending protected propagation may be seen in the re-establishment of the shad industries, which a few years ago were on the decline; it will be observed that (with the exception of the removal of obstructions from our rivers, thus allowing the fish to ascend for the purpose of reproduction), protective legal measures regulating the fishing have been practically null and not required to save the shad from almost total extinction and build up the industry to its present proportions—protected propagation with that one necessary law having done the work.

Shad ascending the rivers only for the purpose of reproduction are caught only during their spawning season (practically) and as mature fish, and the young shad, probably three inches in length, which leave the rivers in the late fall or early winter to return to the sea and remain there until maturity, which is from three to five years, are practically beyond man's dominion, and comparatively no immature specimens (or young shad) are wasted by out nets. With fish which are not bed-guarders, I think that an observation of the effect of protected propagation on the shad fisheries is sufficient proof that for such fishes there should be no closed season during the spawning season, for then is the harvest and let us reap, but, of course, save seed for the next sowing. Whitefish not being anadromous, and the young remaining in the lakes the year round, require protection, which our laws do not seem to furnish. More than one-half the whitefish caught are under two pounds' weight, and about one-half of those weigh less than one pound. This is wholesale slaughter, and a sin! A great many more so-called protective statutes have been passed pertaining to the whitefish industry than to the shad, but the increase in the annual catch of the former the past few years has not been so remarkable as in the case of the shad, and the reason to me is very evident.

Protected propagation has done its part in both instances, but bad laws relating to our whitefish industry have, to a great extent, counter-balanced the good effects of fish cultural work, one of the most unwise and destructive features being the denial of proper protection to immature specimens. The laws that assisted man's protection to nature in the recent re-establishment of the shad fisheries have been very few, but entirely co-operative. However, in spite of injudicious licit measures, and the most persistent and destructive methods of fishing for lake trout and whitefish in the Great Lakes, it has been possible to assist nature to such an extent, by the aid of protected

propagation, that the annual catch of whitefish in Michigan waters during the fiscal year 1896 was an increase over the previous year by more than 12 per cent, and during the year 1897, the percentage of increase over the preceding year was in excess of 22, making an increase over the year 1895 by a trifle more than 38 per cent.

Taking for my guide, the fluctuating condition of some of our very important fisheries in years past, with reference to their alternating periods of depreciation and enhancement, I have made some study of the laws which pertained thereto, by noting the results of various changes in so-called protective legal measures, and I am firmly convinced that a few wise laws, and their rigid enforcement, are just as essential to the future development of our fishing industries, as is fish cultural work itself. We have had some good laws passed for the protection of the young whitefish, and also the immature specimens of lake trout, but owing to defects and loopholes in these laws but little has been accomplished in the way of enforcing them, and up to within three years ago there was practically no enforcement of law at all for the protection of immature fish in the Great Lakes. To me, this subject of protection is the trunk of which all other fish cultural questions are but branches. The plan may never be perfected, even by succeeding generations, but necessity will demand a more thorough understanding of the question of protection; and present conditions, with the future outlook, seem to assure me that the coming sages of political economy will engage their minds in the solution of the problem, and the art and science of fish culture will eventually become a part of the curriculum in our Agricultural Colleges. Fish culture has reached that stage of perfection where billions of fish can easily be hatched, but the more important questions which now confront us are, how can they be subsisted, protected and made to grow? Millions and millions of acres of productive water lie waiting to be converted into fish farms.

It does seem a great step from this plane of perfection to the next higher level, but these are the questions which address themselves most gravely to the student of modern fish culture.

Our Creator, in forming this earth, bequeathed a far greater portion to fish kind than to mankind, and plenteously stocked the waters with fish life upon which man has partially depended for his meat diet since the time of Peter, the Disciple and Fisherman.

Now, is it not an alarming condition that as man's small allotment of the earth's surface becomes more and more crowded, the fish life in the public waters is gradually declining? There are many fishes whose habits and characteristics

are too indefinitely known to properly apply protective methods, and with these instances a gradual decline of the industry is a natural result. It is claimed that at the present rate of decrease, the oyster, which is of such great intrinsic value to our people, will become practically extinct within the next ten or twelve years. The public waters cannot be conveniently utilized in the establishment of cities, but with proper assistance and protection to nature, they are admirably adapted to furnishing all cities with an abundance of fish diet. If proper remunerative encouragement were offered by our Government for the insured establishment of a successful plan to repeople the public waters with valuable food fishes, thus making food cheaper, affording a remunerative outlet for labor, building up a National industry, increasing our public wealth, encouraging the advancement of science and art, and finally to more than re-imburse our public treasury by increased revenue from our fisheries, in years to come, it is my belief that many of the best talented minds in our country would set to work to accomplish the desired aim.

It would be capital well invested, and if the acquired results were not quite so perfect as anticipated, the money would still be expended in a profitable and commendable manner, and it would pave the way for future accomplishments in this line. Within the next fifty years, there may be as great a revolution in the introduction and employment of new protective methods as there has been the past fifty years in the application of electricity. The achievements in electrical science seem to have been realized out of nothing to begin with. The germ has to be detracted from the elements, then bottled—so to speak—before it can be made to manifest itself as useful energy employed as man's servant to be used at his will; but with the fish germ, it is different. We can locate it without difficulty; it does not have to be manufactured or separated from atmospheric phenomena by means of complicated machinery. We have passed that stage of investigation where the germs in countless numbers can be called into life, and we now seek a class of protection which will insure the maturity of the living germs.

It will be noticed that even so far as my own special line of work is concerned, I have not attempted to discuss this question of "What is protection to food fishes?" although, I feel that, with one or two exceptions, I am prepared to name the class of protection most applicable to the different fishes propagated at the Stations under my charge. My prime object has been to impress upon you the importance of the question which I have selected, and ask that you take up its discussion at our next meeting as it pertains to your respective lines of

work, and thus give the rest of us the benefit of your experience. Therefore, I recommend that this Society urge upon its members the necessity of a more comprehensive study of this subject, and that this question of "protection" be taken up in its different phases and at our next meeting as many papers as can be prepared on this topic, be read before the Society and discussed by the members.

DISCUSSION OF MR. CLARK'S PAPER.

Mr. Gunckel: Mr. Chairman, that is the great question which has been agitating the Fish Commissioners for the past fifteen or twenty years in the State of Ohio. Whenever they seem to get a law that is right for the protection of the fish, the commercial man, backed by wealth, will go to Columbus and so impress upon the various committees the importance of changing the laws to suit his manner and way of thinking that no law ever has been introduced yet that has proven successful. Today on the reefs of Lake Erie we have a new invention called the trap, which is absolutely destroying the black bass. I presume most of you have noticed recently Ex-President Cleveland's trip to Middle Bass, in an article in one of the Eastern papers, where he pronounces it as an absolute shame that the United States did not take this matter up, and that the fresh water lakes, particularly Lake Erie, should be protected similarly to the way Canada protects her half of Lake Erie. When I went down to Columbus and told these Fish Commissioners that something ought to be done, they say that they have this to meet, that while they will do something which looks right and proper for the protection of the fish, Michigan, New York, Pennsylvania, bordering on Lake Erie, will have different laws, so that they conflict, and while in Ohio we are not allowed to fish beyond the 10th day of June, Michigan will fish and take the fish that would naturally run into the waters of Ohio. So it looks to me as if we must fall back to the distinguished and sensible representatives of the United States. I do not see any other way. After hearing the able and very interesting article which has been read, how they can produce fish here almost by charm, I think they can do most anything. I think it is a subject if it was introduced at our next meeting that would, if the gentlemen from the northwest were brought here, occupy the entire time. I do not think we can ever accomplish anything except to appeal to the United States. I would like to hear from Mr. Stranahan on that subject.

Mr. Stranahan: Mr. Chairman, I believe, so far as we know,

all the United States Court decisions have been to the effect that the United States has no authority over those waters. There have been a number of decisions, and I believe all have been in that direction. Mr. Ravenel is better acquainted with that matter and with the law than I am.

Mr. Ravenel: It is simply a matter of guess as far as I am concerned, but we have always understood and I think the State Courts have been sustained by the United States Courts, that the jurisdiction of the Great Lakes rests entirely with the states bordering on the lakes. In Canada it is entirely different. In our country each state passes its own laws and enforces them and the United States has no jurisdiction whatever over inland waters or lakes.

Mr. Titcomb: I would like to inquire if there has anything been done towards the states ceding their rights to the United States? If these states bordering on the Great Lakes should cede their rights or their jurisdiction over the fish of those waters, would it not then be possible for the United States to enact proper protective laws which would be uniform?

Mr. Bowers: It would necessitate an act of Congress.

Mr. Titcomb: I understand if every state should cede the control of these waters, then the United States, through Congress, could enact laws protecting the fish.

Mr. Ravenel: I know that at present we have no jurisdiction.

Secretary Whitaker: I believe this matter was brought up in the Supreme Court of the United States many years ago and the first decision was rendered by Chief Justice Washington, and uniformly from then down to Chief Justice Waite, whenever the United States Supreme Court has been called upon to pass upon this question its decision has been that the power of police regulation under the constitution as it was adopted was reserved to the individual states, and that the United States Government could not exercise it. That is the condition of the law, and it has been the decision of every court of inferior and superior jurisdiction in this country. I think that may be said to be true without any sort of qualification.

Mr. Ravenel: It would require a constitutional amendment, would it not?

Secretary Whitaker: It would require a constitutional amendment, an agreement to it by the states. I would say in that connection that last fall I was invited to appear before the High Joint Commission at Quebec on this very question, and I took occasion to say certain things to them upon the matter, and very likely that will be one of the questions that Commission will decide, if they ever decide anything, in the near future.

Mr. President, and gentlemen of the Society: I desire to say something upon the paper that has been read by Mr. Clark. A twenty years' connection with the fisheries of the Great Lakes has given me some familiarity with the subject, and the facts so far as they exist will bear out the statements I shall make.

Something over thirty years ago the United States Government, in considering the interests of the people in the fisheries, decided that the propagation and the protection of commercial fish and the causes of their decay, were subjects which warranted the government in instituting an inquiry. That inquiry was made, and as a result the United States Fish Commission, eventually, came into existence. Following that the different states of the Union, to a very great extent, appointed commissions whose purpose it has been, as it has been that of the United States Commission, to propagate fish, and to recommend such laws as would subserve the public interest in the protection of the fisheries.

The question of protection of the fisheries is not a new one. It is one of very grave importance. It has challenged the attention of the people from time to time ever since I have known anything about the commercial fisheries of the lakes. Various bodies have met together from time to time that were representative of the fish commissions, and of the commercial fisherman, to consider and settle this question, if possible; but I say, without any fear of contradiction whatever, that today, on the Great Lakes, notwithstanding all these inquiries, we are practically without laws for the protection of fish.

In 1892 this question was thought to be of sufficient significance by the Canadian Government, to open a correspondence with the State Department at Washington, suggesting a joint commission to inquire into the causes which had brought about the present condition of the fisheries. After the usual routine that is necessary between officials, there was eventually appointed a representative on the part of the United States, an expert by the name of Richard Rathbun; and a gentleman named Dr. Wakeham representing the Canadian Government. Those gentlemen made a very thorough examination into the present conditions and the past history of the fisheries of the Great Lakes, and the things that should be done to protect them, and they joined in a report to their governments which has now been before the public since 1896.

The condition of affairs on the Great Lakes has been this; that with the exception of a brief space of time during which the harbors of the Great Lakes are closed by ice, there has been no protection to the fish. Laws have been passed from time to time in my own state regulating the meshes of nets.

These, through the insistence of the commercial fishermen, have been repealed, and today I say, without fear of contradiction, that the fish are practically without protection on the Great Lakes. Each state claims that the other does not protect according to its notions; and that there are differences that ought to be reconciled, but up to the present time there has been no reconciliation of differences. I do not entirely agree with this view of the matter. I believe on the same theory a state might complain that it could not fix the legal rate of interest at five per cent because a neighboring state fixed it at three, and that therefore, there should be no legal rate of interest established. It is the state's first duty to protect itself, and that is what the state should be expected to do.

There are two great movements of fish in the lakes; to the deep water for feeding, to the shoal water for spawning. Those movements are as well known and as well recognized, and always have been by the fishermen as by the fish themselves. The mesh of gill nets in 1840 on the lakes, and to about 1866, was five and a fraction inches, to six inches, differing in different localities. The meshes of other nets were correspondingly large. They did not need to be smaller because the fish were large enough. There was then no market except for such fish as were caught in the fall of the year. But the country grew, and today we have in the six states bordering upon the Great Lakes one-fifth of the population of this country, saying nothing about the great population that we furnish with fish beyond this territory. Then freezers were built, and it was possible to take the glut of a season and preserve it for the market for an entire year to be marketed in addition to what was taken in the season following. The fish are fished for during the summer months, and they are fished for during the fall. As the fish began to decline in size the nets gradually began to contract until they were finally reduced to the present size. A very good illustration can be cited of the value of good laws in protecting the fisheries, on our boundary waters. The National boundary of the great lakes extends through Lakes Huron, Erie, Ontario and Superior. Lake Michigan, lying wholly within the jurisdiction of the State of Michigan, is today, with the exception of trout, practically barren of its best commercial fish. The white fish industry has come to be of little importance on that lake. But on those waters on the international boundary the Canadian Government has for years established a closed season for fish in the month of November, which it recognizes to be the spawning month. It has regulations that provide that trap nets shall not be set beyond a certain number of cribs in a string and provides that there shall be certain gaps between strings of nets. It

imposes a license upon those who enjoy the benefits of the fisheries; and my opinion is that Lake Huron, Lake Erie, Lake Ontario and Lake Superior would be in the same condition as Lake Michigan if it were not for the fact that one-half of the waters of those lakes are protected by law. For years the Canadian Government has sought co-operation from the states adjoining their boundary so that laws might be passed that would agree with their own and give the needed protection, and two years ago Michigan proposed laws to protect the fisheries during the spawning season.

Let me here say that there is pretty good authority as to the necessity for a close season, furnished by the official report of the United States expert above referred to that may be properly referred to in this connection. I have not had time for the preparation of a paper, but there are some things that I would like to call attention to in this report which I have here, which seem to me to verify and carry out the idea that the fisheries do need protection and need it badly, and that the closed season is one of the things to be recommended. (The speaker here read quotations from the report referred to.) Now, there is no difficulty whatever in a state passing a law if it chooses, making a closed season, such as these gentlemen recommend, and which has been recommended or favored as far as I know, by most every meeting that has been held to consider the protection of fisheries. If such laws are passed by a state, it does not necessarily follow that because a closed season is fixed, fish-culturists cannot secure the ova of fish with which to carry on artificial propagation. Power is possessed on the part of the states to pass such an act as is now upon the statute book of Michigan, permitting their Boards of Fish Commissioners to take fish for purposes of artificial propagation at any and all seasons of the year when necessary. So there is no argument in the claim that because a state imposes a close season for the protection of fish in their spawning season, the work of artificial propagation must cease. The trouble has been heretofore that the tendency of legislation respecting the fisheries has been towards a protection of fishermen in a right to fish at all times of the year, and not to a protection of the fish. When you take an industry which you pursue ruthlessly from one end of the year to another, without restriction as to size of mesh, without restriction as to size of fish, without restriction as to fishing on spawning beds, you will find that what has happened will always happen. We find the whitefish catch declined in Michigan from eight million pounds in 1885 to three and a half million pounds five years later. Now, where are you going to get your whitefish, with this continuing decrease? Where are you going to get

your parent fish to breed from in a few years? What is the present condition of Lake Ontario, which the United States is attempting to restore? They can not find whitefish enough in Lake Ontario with which to stock their hatcheries at Cape Vincent on that lake.

A comparison is instituted in the paper between shad and whitefish, but that argument is faulty. Notwithstanding the Great Lakes are, as it would seem, almost illimitable in their extent, they are indeed restricted areas which can be surrounded and are surrounded by nets on every side. They are fished from one year's end to another; in season and out of season; in the summer; in the fall and in the spring, and so far as possible, in the winter. On the other hand, as Mr. Clark has said in his paper, the shad is an anadromous fish. God Almighty protects that fish about eight months in the year because it goes out into the ocean where the nets cannot reach it. It does not need the legal protection that fish do in the restricted areas of these lakes. The consensus of opinion of this body has been, and it has been so expressed within three years, that a greater protection to fish should be given. It has recognized the necessity of protection. Everybody recognizes it. It appeals to good judgment. It must be done if you are going to keep your fisheries.

We have had this question of a close season up in Michigan, and the attempt was made to repeal the measure at this session of the Legislature, but it was not accomplished. The attempt was defeated in the Senate although it passed the House.

We have an organization in Michigan called the "Michigan's Fisherman's Association," I believe—alias the Michigan Fish Trust. It has been fighting with people whom they call the Chicago Fish Trust. This Chicago Fish Trust appeared there, so far as my information goes, as an advocate in favor of sustaining the closed season. The Michigan Fish Trust said, "They want to keep up the market prices of fish." So far as these organizations are concerned, I care nothing for them; but if either trust is to be trusted the Chicago Fish Trust is the safest one.

Now, let us see what this Michigan's Fisherman's Association, otherwise properly denominated the Michigan Fish Trust, has done in Michigan in the last ten or fifteen years. Two years ago the Michigan Commission succeeded in getting one bill passed. We presented three bills; one in accordance with the suggestions made in this government report I have referred to, that if you are going to control and regulate fishermen you must license them. They defeated that bill easily. Another thing we proposed was the enlargement of the meshes of the nets, and the other was for a close season of November. These

matters were all discussed in our Board and agreed upon beforehand, the majority disagreeing with the proposition that the gill nets should be four inches. They thought they ought to be five or more. I agreed with them, but suggested that we should take what we could get; that if we could get them to open the mesh a little we would see if we could not get them in time to open it further, and I opposed putting in a bill that would be defeated because of the extreme size of the mesh asked for. That law was passed fixing the mesh at four inches, and it has stood on the statute book for two years. But what has occurred this year? But I am anticipating, and I want to say before I go to that, that the Michigan Fish Trust has been all these years claiming to us: "For God's sake do not put your regulation on the twine, you are doing away with millions of property; you are practically confiscating it." So a provision was put in allowing three years to fish out the twine. That was certainly long enough. They have always met every proposition the Michigan Commission has made in the way of protecting fish by saying that the only way you can do it is to fix a regulation as to the minimum size of fish that may be caught. They said that the whole matter could thus be regulated and that they would favor such a law. The answer to that, of course, is apparent to every one. You would have to have a warden at every net to watch and see what they were doing. But without any interference whatever these people went to the Legislature this year and passed a law prescribing a limit of size of fish; for whitefish two pounds, and a limit for other fish at other sizes. Then they went to work and in the closing days of the session reduced the size of the mesh to three and one-half inches; and to cap the climax, almost on the last day of the session, the Legislature, at the instance of the Michigan Fish Trust, passed a bill legalizing the sale of fish of any size caught in any legal sized net. Now, what was the result? I discovered that provision a week ago last Saturday, and wrote to the Governor calling his attention to the facts and he vetoed the bill.

Now, if you are going to give protection to fish at all, and you must give them some protection, here is a pretty good thing to call your attention to as to its necessity. The Pribylov group of islands lies off the peninsula of Alaska. Within a certain hour of a certain day of almost every year, the fur bearing seal, through the instinct of nature, comes there to reproduce its kind. It is their spawning season, their calving season. The United States Government has been attempting for a number of years to regulate that fishery, to save the seals; and the decay has resulted notwithstanding that, the only time they are fished for is in the season when they propagate.

Now, if you are going to give any force and effect to this work of propagation you have got to act honestly in it. It is not the province of a commission to do anything but its whole duty. Let us not magnify the importance of our office, nor be swallowed up with the idea alone that we are Commissioners. Let us thoroughly appreciate that we are public officers charged with a public duty, and that we must not temporize with people who are attempting to destroy their own privileges. Let us act faithfully and honestly. That is our work. That is the moral side of it. If you want to take the other side, take it. Does it pay? Michigan has put into its waters since the Commission was established one thousand million whitefish. One billion. The United States Commission in the same time has probably put in a quarter more—perhaps I am understating it. But those are large figures, and what is the result? Our whitefish fisheries had fallen from eight millions—and no one knows how much more, because those were the figures when we first took statistics in 1890—to three millions. The statement is made that these fisheries have increased within the last two years. Nobody can really tell that, for this reason, that it has not been taken for the last two years; it is being taken now for the last of the two years mentioned. We get our statistics by going to the fishermen and asking them what their catch is. What is the situation, and what is the animus that has controlled these fishermen? Two years ago a close season law was passed. They got out an injunction against the warden to restrain him from enforcing the law. It was a most novel proceeding, and the judge who enjoined him was reprimanded, on appeal, by the Supreme Court, for having proceeded in that way. But that is the course they took and they succeeded in staving off matters, for practically the whole season. They intended to come to the Legislature last year to abolish that law, and they had to come well fortified, and they came there claiming an increase in the last two years. From an examination I made of the statistics I found, I think, there were only two varieties that showed an increase. One was herring and the other was whitefish. I took one small district, and the figures showing increase of whitefish were astounding; the first time it had shown an increase since we have known anything about it. These figures are open to challenge the same as are the facts in a case before a jury. Now, do we care nothing for this condition of things? The fact is, your fisheries are going. You have got to have some practical way in which you can bring about protection. You cannot restore the stock by propagating fish alone. I know as well as any one how effective that work is. I am not disputing that proposition. You can do better in the way of artificial

propagation and distribution than by allowing "Nature to take its course." Yet notwithstanding all the efficacy there is in modern fish culture, you cannot perform a miracle with it. The idea that you must protect animals at certain seasons of the year is recognized all over the earth.

But I misspoke myself when I said that we had no protective laws in Michigan. We have indeed. Two years ago a man from one of the fishing districts of the State which has been most violent in its opposition to laws protecting fish, presented and had passed a bill to protect muskrats! And a bill was introduced at the last session to protect mourning doves! I do not know whether it passed or not. Wapiti are protected by Michigan laws, but not one man out of ten dozen in Michigan knows what the devil a wapiti is. (Laughter.) There has not been one seen there since the flood, nevertheless, they are protected. The State looks after muskrats, mourning doves, and wapiti with the utmost solicitude. The Michigan Legislature adjourned recently, and the most arantly partisan republican paper we have in the City of Detroit lambasted that Legislature for its inefficiency and for other things, although it was of their political faith, and said that it was "no good." It reminds me of a story I will tell you: Several years ago a man named Neasmith was elected senator from Oregon by one vote. His friends began to inquire of him about it, and to address him in this fashion: "Now, Neasmith, you are a good fellow, but we wish you would tell us how the deuce you got that vote?" Of course, life began to be a burden to Neasmith after a time, but finally he went to Washington to take his seat. Not having that close and intimate acquaintance with the senators in Washington that he had at home, when they began questioning him in Washington on the subject he could not say to them what he felt. But finally in the course of time he was relieved, and so was everybody—the Senate adjourned, and he went home to his constituents. One of the first men he met on his return was the governor of Oregon, and what he said to the governor may well be said of the Legislature of Michigan—although I do not challenge the Legislature of Michigan to the extent my words might seem to imply, for there were good men there although the other fellows preponderated. Now let me tell the balance of the story. He met the governor, who said, "Ah, Neasmith; back?" "Yes Governor, just came back." "Well, Neasmith, what is the news in Washington?" "Oh, everything is going on nicely down there." "Neasmith," said the governor, "there is a question I want to ask you. You were elected senator from Oregon, but you were only elected by one vote; now where did you get it?" "Well, Governor," said Neasmith, "come here,

I do not mind telling you," and he took him by the lapel of the coat and led him off into a corner; "this is the situation of things," said Neasmith, "the night before the vote was taken I needed one vote and I needed it badly. There was one man in the Legislature whom I thought I could persuade to help me out. I got him up to my room, seated in a chair, gave him a good drink of whisky and a cigar, and I said to him; now see here, Jones. I want to be United States Senator from Oregon. I want one vote. How much will you take? 'By gosh,' he says, 'that's the kind of man I like to hear talk. You talk business; you're all right. What will you give?' 'Well,' I said, 'how would one hundred and fifty strike you?' 'One hundred and fifty hells,' said Jones, 'I paid the Governor of Oregon three hundred dollars for pardoning me out of prison.'" (Laughter.)

Gentlemen, I could not let this matter pass without some suggestion on my part of the facts as I have known them. I could have very much better presented this matter in a paper, but I have not had time to prepare it. My life is busy; therefore with these few remarks I will conclude what I have had to say on this subject.

Mr. Clark: The gentleman's remarks so far as my paper is concerned are wholly unwarranted.

Secretary Whitaker: In what respect?

Mr. Clark: Simply because my paper does not touch on the protection of the fish of the Great Lakes alone; it is more general—touching on the protection of fish everywhere. My paper is broader in scope. I only mentioned the fact of the closed season for whitefish, and what laws we do not have about the black bass, just to compare spawning habits of the two kinds of fish. In this whole matter I am not concerned about the fishermen one way or the other, and have not had that idea in my head at all. I was simply looking upon the question as a practical fish culturist, and I have closely observed the work on the Great Lakes and elsewhere for thirty years. That is what has brought out everything upon this subject of protection. There are a few things I would like to answer in Mr. Whitaker's remarks, as long as he has touched on this subject. I want the gentlemen to understand that my article was in reference to the question of protection throughout the whole United States; not confined to the protection of lake trout or whitefish alone—but to everything, everywhere—a different kind of protection, as I said in my paper for different kinds of fish, according to the conditions. The characteristics of the fish must be studied in all matters by our scientists, and especially as to the protection of the food. I think the food question has as much to do with their perpet-

uation as anything in the world. We must have protection for their food, which is being destroyed all the time, in the lake and rivers and everywhere. By what? By the sewage of the cities for one thing. I think the time will come when our scientists will recognize that fact, and I do not know but they have already. Mr. Whitaker made some statement in regard to Lake Michigan being depleted of whitefish, and Lake Huron and Lake Erie being on the increase.

Mr. Whitaker: No, I did not say Lake Erie, or Huron or Superior were on the increase, or even holding their own. I said they were better than Lake Michigan because they had the protection afforded by good protective laws on the Canadian side of the boundary.

Mr. Clark: The closed season?

Mr. Whitaker: Yes, the closed season, and not only that, but the regulation of the distance the nets should be set apart, the number that should be set in a string and the size of the meshes.

Mr. Clark: In those lakes, beyond Lake Erie, we have something else that has not been taken into consideration, showing why the fishing is better in Lake Erie, and it is conceded, I think, that the fishing is better in Lake Erie than in any of the other lakes, for whitefish especially. As Mr. Whitaker says, during the years since the organization of the Michigan Fish Commission and the United States Commission the total plant is represented by a thousand million, or something like that. The actual figures are one and a half billion, and of that number five hundred and fourteen million went into Lake Erie and the balance into the other lakes. One third of all the fish that have been hatched by the Michigan Fish Commission and by the United States Commission have gone into Lake Erie waters.

Mr. Whitaker: But the balance has gone into the other lakes.

Mr. Clark: Have been scattered in Lakes Michigan, Huron, St. Clair and Superior; Huron getting the most of those fish, Michigan next, and Superior next. That is one of the reasons, in my judgment, why Lake Erie is so much better than the other lakes; from that and not from the closed season. Again, we have another thing Mr. Whitaker brought up; he rather criticised the figures I gave in regard to the increase in fish. Now, where I say "it has been possible to assist nature to such an extent," etc., Mr. Whitaker rather questioned that data. Allow me to state that I took it right from your statistical agent's report.

Mr. Whitaker: I do not criticise the correctness of your figures. I criticise the conditions under which they were taken

and the temptation that there was to the fishermen, in view of the fact that a time was coming when they wanted to try to repeal the law, to change those figures and make them larger than they ought to be.

Mr. Clark: The figures go back to 1895, 1896 and 1897.

Mr. Whitaker: I do not know about 1896, of course.

Mr. Clark: I wanted to make known where I got my figures, so that it shows that they are on the increase. The figures show that the fish are on the increase, if those statistical figures are good for anything, and I suppose they are. They ought to be as good as any data.

Mr. Whitaker: They are as good as we are able to get.

Mr. Clark: They are as good as we can get. Now, Mr. President and gentlemen, the idea I have has nothing to do with the fishing. It is not my aim to protect the fishermen there. I simply want more fish in the waters. The fish culturists of the United States have accomplished one thing, and that is that they can hatch fish by the billions. We have gone by that. That is all fixed; and we must now do something more. We shall have to grow those fish. And why do we not do it? I take the ground that the class of fish that do not take care of their eggs are a class we should hatch, because there is such a waste. I can show you by an article I have here, delivered before the Legislature, concerning whitefish penned by Mr. Stranahan at Monroe, that we actually did get about ninety million eggs, and I figured out that we hatched at least sixty per cent, or about sixty million, and there is not a fish culturist in the country that I have ever found who does not say that I am too high when I allow one and one-half million if they were spawned naturally. We put sixty million in the water against one and one-half million by the natural process. Whitefish do not take care of their eggs. They spawn indiscriminately in the water. The female will throw her eggs when there is not a male anywhere near her. That is the idea. Black bass do not do anything of the kind. They can beat the artificial method. We can not begin to come up to them in artificial work. So this is the ground I take—that the kinds of fish that are free spawners and spawn indiscriminately, such as the whitefish, should be taken care of by the protective methods. That was the idea of my paper, but my article was broad and I did not intend to touch on any particular section or kind of fish. The question was upon the subject of protection in all its phases, and what I really wish the Society would do next year is to bring in their different ideas of protective methods for different fish. This idea of a closed season—why, we want the fish. That is what they are there in the water for. Another thing, if you take those large fish

out of the water, you leave the food for the growing generations that are coming on. The other day I caught a rainbow trout, I hooked the fish for a Presbyterian minister and let him land it; he was so anxious to catch one. It was just below the hatchery in a little stream. It weighed at least a pound and a quarter, or a pound and a half, and was a nice large rainbow trout. I opened the trout and took out its stomach and carefully examined it. I took eleven little fish out of that rainbow trout's stomach, those being a portion of the undigested contents, and everyone of them was either a brook trout or a rainbow trout, and there was a mass there that looked as if they were fish that might have been hundreds in number. Now, that rainbow trout should have been out of the way, because it was destroying the generations that were coming on. That is the idea, to get the larger fish out of the way. We want them to catch and to eat and to have them out of the way. A great many other things Mr. Whitaker said, I might discuss, but I shall not do so at this time.

Mr. Preston: There were some of the matters in Mr. Whitaker's address I desire to reply to briefly. Two years ago when this question of a closed season came up I as a member of that Legislature used my best efforts to help get the measure enacted, for a closed season for Michigan, for whitefish and trout in the Great Lakes. That measure was enacted into law and the result was that the wealthier fishermen, the large fishermen, formed themselves into a trust. They had capital enough to buy and use the appliances for freezing. They caught just as many fish only they caught them earlier. They closed up during the closed season and the consumers of fish, we who bought them, ate just the same fish as we would have eaten only the fish were not quite so fresh and we had to pay more for them. That was all that was accomplished by that closed season legislation. As a matter of fact the smaller fishermen became practically a class of law breakers or attempted law breakers. The State of Michigan, by spending a large amount of money for game wardens and deputy game wardens to control the waters, succeeded in a reasonable measure in keeping the fishermen within the bounds of the law, but it was only by the expenditure of much money for salaries and expenses for the game wardens. If the same amount of money that had been spent for this purpose had been devoted to the Fish Commission for re-establishing the whitefish a great deal more could have been accomplished than was done by creating the closed season. I am of the opinion that the true policy for any state or for the Government is to make liberal appropriation in the way of propagating fish and raising the young fry doing everything to keep them from being killed off, studying

their habits and the diseases that annihilate them and doing all that can be done towards keeping the waters stocked. Then, if the people want to catch them let them go ahead and do it.

Mr. Dickerson: Mr. Chairman, I am not going to discuss this question, but I want to say, that until the Fish Commission was organized, A. Booth & Company fought against a closed season. There are many letters on file in which they agitated that question. They were not converted until they had organized a trust and got control of the fisheries on Lake Winnipeg. During the agitation in the Legislature this winter a Canadian who has been in the fishing business all his life, reading the papers and taking an interest in the subject, sent a long communication to us in which he goes on to show, that notwithstanding the protection which has been given in every way in Canadian waters, that the supply of fish had decreased by a much greater percentage in those waters than in our own. I think it a very wise thing to agitate this question, to bring up all the points we can in reference to it, and to make it a special study and subject of discussion at our next session. I desire to offer this paper in order that it may be printed among our papers. I am sorry I haven't it here that I might read it at this time. It is something that will be instructive and will give us the facts and statistics as he has compiled them. It shows conclusively that the decrease is much greater in the Canadian waters, notwithstanding their so-called protection, than in our own. The paper will be of interest to every man who has made a study of these questions and for that reason I desire to ask permission that it be printed in our report.

President Peabody: I would like to ask if that depletion might not be largely due to the continuous exhaustion upon the other side?

Mr. Dickerson: Do you mean by our waters being depleted?

President Peabody: Yes.

Mr. Dickerson: No, theirs are depleted faster than ours. This goes back for twenty years, and shows a much greater percentage of decrease in Canadian waters than our own. I think it would be a valuable thing to have the paper printed in the report, and I offer it for that purpose.

Mr. Whitaker: Mr. Chairman, I have some statistics I would like to introduce in connection with that very question, and in connection with my remarks here, and I would ask leave to do so, because I do not want to tamper with the record after it has been made.

Mr. Stranahan: I would like to ask Mr. Whitaker how he would supply hatcheries with whitefish eggs or cisco eggs, or

herring or lake trout for the closed season in November, in any place except the Detroit river. For instance, our hatcheries at Put-in-Bay; how would he supply it with eggs with a closed season in November?

Mr. Whitaker: I am glad that point has been raised, because there is something in connection with it that I had intended to say. When the question is mooted as to the enlargement of whitefish work on the lake, I want to say that on the facts we had reached that limit, practically before that law was passed. We have attempted in Michigan waters to supplement the work on the Detroit River by taking spawn elsewhere, but found we had practically reached the limit of what we could get. Now, to answer the question directly I will say this. All good law means the greatest good to the greatest number. I do not agree at all with the remarks that have been made by my friend, that it is the business of the Fish Commission to let these men, if they want to, fish out these waters, and that it is their interests more than any other that wants to be subserved, and it is they who are suffering more than anybody else. I cannot agree with him, because the real question is: Can we, as Commissions, maintain under proper regulations a great food supply that practically grows in the water without care or cost to the public, as interested in this question as anybody else. The fisherman is directly interested in it because of the amount he gets from the industry, but after all this is the great question, how can we preserve the fisheries and stop the waste, and no commission lives up to its possibilities which does not consider it, and all other questions are incidental to this. Here is a great food product that should be maintained, and the people of this country are more interested in that question than all fishermen on earth can be. It is a question of maintaining a cheap food for the people. It is a food that grows without the hand of man from the time it is put in until it comes to maturity. I tell you this is a great public question, and no set of men, whether it be a fish trust or the fishermen, have any right to prejudice the interests of the public in a source of food supply because of their own selfishness.

So far as this particular question of Mr. Stranahan's is concerned, I will say that it is within the province of every legislature to grant just the thing you desire and just the thing we all desire, the right to Commissions to fish for seed in spawning time. We have such a law in Michigan today. It was not because we could not fish in the closed season that we stopped, but it was because the fishermen had power and strength enough to go to the Legislature and say they would punish the Fish Commission for presuming to hamper them

by any sort of law, by cutting the appropriation, and they did it. It was not because we did not have the law by which we could act; it was because these men sought to hamper us in this way, as a rebuke to Commissioners who draw no money for work, who want none, and who have worked faithfully in the interests of the State. Yet they characterize us as men who have a selfish interest. We have nothing but the interests of the public at heart. This thing that you speak of can be taken care of. You can get your eggs as can every other Commission, by a law passed permitting you to get them during the closed season; of course, with proper restrictions. I would go a step further than has been done in Michigan. The law ought to be, and the United States Commission can do now, what we have never been able to do, return every stripped fish that was in good condition and likely to live to the waters, and not market it. We have been forced to market fish because of the small appropriations we got from time to time.

Mr. Clark: Mr. Chairman, there is one point there it does not seem to me the people grasp. It is not the idea of how to run our hatcheries. If the closed season is the right thing, if natural spawning is the right thing, the artificial or protective propagation is wrong. They cannot both be right. If the process of a closed season, allowing the fish to spawn themselves, is the right method, then the other is wrong, and I do not think the point is well taken as to how we are going to run the hatcheries; that is not the question at all. The question is how you can save and return the most fish to the waters. That is the question. It is not by their spawning naturally, for nobody for a moment would think that you could put in as many as you could if they were protected. You simply get the eggs and protect them until they come to a certain stage. It looks to me like saving those eggs. They are wasted, all but a fractional percentage of the whitefish, if they spawn naturally, but if you have those eggs and protect them and take care of them and plant them in the water you plant a moving, living thing, but if they spawn in masses as they do sometimes, it is simply a wholesale waste. The time to protect your adult fish, the time to make your closed season, is when the most unripe fish are caught, because every unripe whitefish that is caught means thirty to seventy-five thousand germs wasted.

Mr. Whitaker: May I just say a word further? The point of it is this, you can fill this country with Fish Commissions, put them on every square mile of land, and it is not possible for you to spawn all whitefish that are taken in the month of November. The point is take all you can, but do not let the fishermen kill the ova in the rest. This small precentage under

natural spawning that is spoken of would be saved, and that would be an advantage of a close season, but as the United States expert said in that report I referred to we must make some regulation, you must regulate the fisheries in some way, and you must restrict the catch. They say it in those plain words. If you are going to do that I do not know of any better season to establish those restrictions than during the spawning season. Put the ova into your hatcheries, hatch all you can, but do not let a man take those fish that will spawn in the natural way, even though only a small per cent are hatched, and destroy them and market them.

Mr. Preston: What difference will it make whether those fish are protected in November? Suppose those same fish are caught during the month of October. They have all those germs in them and they are killed just the same, and what difference is it going to make if you have a closed season in November, but have allowed these wealthy fishermen to catch these same fish in October and put them in freezers and sell them to us in November when they are not quite so fresh and when they can make a little more money out of us. They have killed the spawn to just the same extent.

Mr. Whitaker: There has never been a proposition to make a closed season at any other time in the year, and no state would pass such a law.

Mr. Preston: But, as a matter of fact, it is true that we have made a closed season in the month of November in Michigan and the fish are caught and put in freezers in October, and the fish are filled with spawn at the time they are caught.

Mr. Dickerson: I want to explain why the trust fought so strenuously on the question of the closed season this year. They control the whitefishing of Lake Winnipeg. Twelve hundred tons of whitefish were caught in Winnipeg last year. Nature makes a closed season there in November. They can not catch any fish then and do not want anybody else to. Now, if we have a closed season they have no competition with the smaller fishermen down in our lakes where nature has not made a closed season, and for that reason our fish are put into the market and the product diminished. If we have an open season they would have the competition of all the small fishermen. With the closed season the trust could absolutely control everything. But that is the reason Booth & Company always favored an open season (until the trust was organized), and the Michigan Fish Commission's office is full of letters from Booth & Company on that subject. They now come in and say: "Gentlemen, we have all the whitefish in Lake Winnipeg; nature makes it so that we can not catch them in the spawning season, and we do not want you to catch fish in

other waters in competition with the Trust." Why did not Booth & Company favor the same laws before the Trust was formed that they do now?

Mr. Stranahan: Last year the commission took one hundred and eighty-five million white fish. We worked the ground from the mouth of the river to below Kelly's Island. We hatched one hundred and three million fry and turned them into Lake Erie. We believe that is more fry than nature could have possibly hatched. Of course, you cannot possibly prove that, but in order to do any fishing on the plan Mr. Whitaker proposes, we would have to fish hundreds of pound nets and miles of gill nets, which, of course, would not be practicable.

Mr. Whitaker: As I understand, that in effect is what our legislature has done this year.

Mr. Stranahan: It permits the commission to fish.

Mr. Whitaker: Yes, and it permits the United States Fish Commission, also.

Mr. Stranahan: They always could, but they had to get a permit. We could do nothing catching our own fish. We would get but few spawners out of many pounds of many kinds of fish, and it would be impracticable for us. I am in favor of a closed season, but I would make it October instead of November. I would close the lake tight shut for six months, three during the summer and three during the winter.

Mr. Whitaker: But you never could get such a bill through.

Mr. Stranahan: We had one, but it was not well enforced. As a matter of fact, the Pennsylvania people, and, in fact, a good many in Ohio fished 365 days of the year. It is only during a cold snap, when they can not get out of the mouths of the rivers, that they do not fish the season right straight through.

President Peabody: A committee was appointed to look up the question of entertainment. A number wanted to see the Falls and the various points of interest. Is it desirable that we close our session and have that opportunity before supper?

Mr. Willard: This question has been rather laid aside, owing to the prolongation of the session. The committee held a little meeting this noon, went over the matter and ascertained a few facts as to what we could see. (Mr. Willard here made a statement as to the various points of interest to be visited and the expense attending the same.)

President Peabody called for a report of the committee on nominations.

The committee on nominations submitted its report, and

on motion duly seconded the persons nominated by the committee were unanimously elected as the officers of the society for the ensuing year.

For list of officers see title page.

Mr. Clark: Mr. President, I would like to make a motion, but previous to doing so I wish to say a few words, if I may be permitted. It has occurred to me that it would be a good idea for this Society to have a committee to call for papers from its members, instead of committing the work to the Secretary. That committee could call on different ones to prepare papers on subjects with which they are familiar. I have no criticisms whatever upon the Secretary. It has been the habit for years to ask members to send in such papers as they have. It seems to me it would be much better to have a committee to attend to that duty. That committee could get together and form a plan as to what papers would be of interest to the Society and could communicate with the different members, asking them to prepare papers on such subjects. I would therefore move that a committee of that kind be appointed, of which the Secretary shall be one.

Mr. de Ravenel: Unless the committee lived within a few miles of each other, or unless it is a committee of one, it would be difficult for them to confer by correspondence to arrange all these details; consequently, in selecting your committee it would be well to take that into consideration. This society embraces people from the Rocky Mountains to the Atlantic Coast, and unless the members of the committee were near together, they would not have very good opportunities for communicating with each other.

Mr. Stranahan: I will offer an amendment to that motion. Our newly elected Secretary is pretty well acquainted with the abilities of the members of this Association, and I move to amend by making this committee consist of the President and the Secretary.

The President put the question upon the motion in this form and the same was duly carried.

Secretary Whitaker: I want to say a word in reference to this program. We were notified that Mr. Fred Mather would present a paper on the "Value of the Gammarus or Fresh Water Shrimp for Trout Food." I have not heard from him. Mr. Titcomb's paper should have come second, but that is to be given tonight in the parlor. Mr. Clark's paper we have had. The next paper is "Observations on an Epidemic in Trout Fry at Allentown Hatchery," by Mr. Meehan. The next one is "Sturgeon Hatching on Lake Champlain," by Mr. Livingston Stone. He wrote me that he thought he would be able to be here with it, but wrote later that the sturgeon had not fulfilled

their part of the business. The next paper is the "Fish and Fisheries of Maryland," by Hon. A. F. George. Mr. George is the only other person present having a paper. I would suggest that we now proceed with the paper of Mr. George.

THE FISH AND FISHERIES OF MARYLAND.

BY A. F. GEORGE.

No other State in the Union, in proportion to its area, has a greater coast line than Maryland. From a bulletin of the United States Commission published in 1894 we find that the States of New York, Pennsylvania, Delaware, Virginia, New Jersey and Maryland have an area of 159,635 square miles of which 7,635 square miles is water. Maryland, with one exception, the smallest of these States, has the largest water area of any mentioned—about 20 per cent of the entire surface of the State being water. New York has 1,550 square miles; Delaware, 90 square miles; New Jersey, 360 square miles; Pennsylvania, 230 square miles; Virginia, 2,325 square miles, and Maryland, 2,359 square miles. Other unassigned waters in Lower New York, Delaware and Raritan Bays, 720 square miles. The Chesapeake Bay, extending into the State for a distance of 120 miles, is from four to twenty miles wide and covers an area of 976 square miles. If we include its tributaries up to tide water we have an area of 2,359 square miles within the State. Then to this we add the inland rivers and mountain streams and we are not surprised to find the fish industry of Maryland to be one of the greatest in the country, occupying, as it does, a place in the front among the States engaged in the fishery industry. Nor are we surprised when the United States Fish Commission tell us that the fisheries of Maryland give employment to more than 41,000 persons, with an invested capital in 1890 of \$7,649,904, having the largest fleet of vessels engaged in its fisheries and the most extensive packing and canning houses, while its fishing products, including shell fish, were valued at \$6,019,165.

In each of eleven counties of the State there are more than one thousand persons employed in this important industry, Somerset county having the largest number engaged in fishing, larger in fact than any other county in the United States, with the possible exception of Essex county, Mass. Of the 23 counties of the State, sixteen of them border on important bodies of water—only one of which—Worcester—borders on

the ocean. The others on the Chesapeake Bay and the rivers tributary thereto.

The census of 1890 shows Maryland to rank first as to the number of people employed in the fish industry, second as to amount of capital invested and second as to the value of products. While the natural advantages which we possess over some of our sister States are those for which Marylanders should be thankful, we can also boast of being foremost in our unsurpassed natural opportunities for improving and multiplying our fisheries. Maryland may well feel proud of the grand fisheries which nature has lavished upon her with such a bountiful hand, but she should not rest satisfied until she greatly improves the vast opportunities she has by increasing these great resources to their utmost capacity, which we believe will be done in the very near future by the thrift and intelligence of her people.

Never before were our people so much interested in this important matter as now. Never before has the public press given so much space to this great question as during the present year, and when the people fully realize the vast opportunities which they possess to increase their wealth by fully developing the fish industry, then it will not be long until our State makes very rapid progress in this direction and the fisheries of Maryland will become the most important in the country. The amount of money appropriated by our State for the artificial propagation of fish is not near so large as the importance of the work demands, especially when we consider the large returns made for the amount invested, but we are expecting great advancement along this line in the very near future.

Prof. Baird, ex-United States Fish Commissioner, has made the statement "than one acre of water properly cared for will produce five times as much as an acre of land." If this is correct (and we have no reason to believe that he who was so well versed in these matters made a mistake when he made the above statement) then what great possibilities lie before the people of Maryland for the increase of their wealth, for the employment of still larger numbers of her people and the furnishing of great quantities of the best food fishes at moderate prices. The thing that is needed to be done to bring this about is to give the Fish Commission larger means to properly develop the fisheries, to propagate the best kind of food and game fishes in larger numbers and enforce proper laws for the sufficient protection of the same.

The rivers and inlets of Eastern and Southern Maryland furnish a large supply of the very best food fishes, while in the rivers and mountain streams of Western Maryland can be

found the bass, brook trout and rainbow trout. In Garrett county, which is the largest in area of any county of the State, there is fine trout fishing. There, nearly three thousand feet above the sea, you can find the beautiful speckled trout in its native element. In that county are more trout streams than in all the rest of the State combined. There brook trout have been caught twenty-three inches in length and weighing four pounds. There you can have the happiness and pleasure of angling for trout and bass which comes to every true disciple of Izaak Walton. The historic Potomac river, which is the southern boundary of the State, takes its rise up in these mountains and runs thence through some of the finest scenery in the country. This river furnishes an illustration of what can be done by stocking streams. Prior to 1853 there was no bass in the Potomac. In that year a lot of those fish were brought from Wheeling Creek, near Wheeling, West Va., in the tender of a B. & O. R. R. Co.'s locomotive and planted in the river. At the close of the war that river was one of the best bass streams in the United States and at this time there are certain parts where the excellent sport of catching large numbers of bass can be had. In 1870 some sportsmen of Pennsylvania successfully stocked several of their rivers with bass taken from the Potomac at Harper's Ferry, West Va. In the lower Potomac large numbers of shad are also taken; the annual catch being about 750,000. Among other important rivers we might name the Susquehanna, Patuxent, Pocomoke, St. Michaels, Choptank, Severn and several others in which there are important fisheries, giving employment to many of our people.

Among the fishes caught in our waters we mention the following, with their local names: Alewife or menhaden, blue fish, sheepshead, butter fish, crocus, sea bass, squeteague, spot, tautog, harvest fish, black bass, brook trout, rainbow trout, sea trout, shad, summer herring, croaker, Spanish mackerel, rock or striped bass, salt water chub, white perch, yellow perch, catfish and others.

The large variety and excellence of the food fishes of Maryland will compare favorably with those of any State in the Union. Of course in this short paper we do not intend to say anything of the diamond back terrapin and the Chesapeake oyster. It would require a longer and more elaborate paper than this one to describe their excellence.

Among our fisheries the shad takes first place. In 1880 the catch in Maryland was 1,074,121, valued at \$140,326. In 1896 the shad catch of the Atlantic coast numbered 13,053,429, weighing 50,498,860 pounds and worth to the fishermen \$1,651,443; of this amount Maryland furnished 1,541,050 shad,

weighing 5,541,499 pounds, valued at \$166,551. The shad is our principal food fish, taking the lead both in quantity and quality. Before the artificial hatching of shad was introduced the supply was very limited but since that time there has been so much attention paid to this important work the supply has greatly increased. Capt. John Tyler, an old resident and fisherman upon the Manokin river, states that prior to 1885 shad were unknown in that river but after an interest was manifested in the artificial propagation of shad and the stocking of Manokin river they have greatly increased for the past ten years and are now being caught in large numbers. This has been the experience with all our rivers which have received proper attention in this direction. With increased interest in artificial propagation, the supply has increased from year to year. In some places where there was one fisherman catching a very small number, now there are ten, and the catch has increased greatly. In shad hatching we commence to strip the fish or take the spawn about April 1st, and continue as long as we can get ripe shad. It takes us from three to six days to hatch them. There is no doubt that had it not been for artificial hatching of shad they would now be almost as scarce as the diamond back terrapin. We have four shad hatching stations in Maryland operated by the State the past season from which 48 millions of shad were distributed. The United States Fish Commission also operates stations at Battery Island at the mouth of the Susquehanna and at Bryan's Point, below Washington, on the Potomac.

It has been well said: "In some respects the shad is the most remarkable of domesticated animals, for it is the only one which man has as yet learned to rear and to send out into the ocean in great flocks and herds to pasture upon its abundance and to come back again fat and nutritious to the place from which it was sent out." From this point of view, the maintenance of the shad fishery by man by the use of artificial means is one of the noble triumphs of human intelligence over nature.

The menhaden is not sold in our markets directly nor used for food by our people, although it is one of the most abundant fishes on the Atlantic coast. As a food for predaceous fishes the menhaden is an important fish and its commercial value is by no means small. The catch in the Chesapeake Bay has been in a single year 92,000,000 pounds of this fish, which yielded 214,000 gallons of oil worth \$85,000; 105,000 tons of guano worth \$210,000; 212,000 tons of compost worth \$19,000, or a product in one year of \$300,000. This fish is very abundant along the Atlantic coast from Cape Cod to Florida and has many local names. There are sixty establishments along the

Chesapeake for the manufacture of menhaden oil and fertilizers.

In the menhaden or alewife fisheries of the United States Maryland holds first place as to the number of fishermen employed, the amount of capital invested and the number of gill-nets, boats and traps. The number of the catch in the United States in 1896 was nearly 148,000,000, weighing 62,000,000 pounds and valued at \$459,600. There are \$26,000 invested in the alewife fisheries of Maryland. In 1896 17,667,315 pounds were taken, valued at \$126,050, or more than one-fourth of the value of the entire catch of the United States.

The bay mackerel or Spanish mackerel, as it is often called, is known to our people as the bay mackerel. It is stated that many of our fishermen had never seen this fish prior to 1875. It is one of the choice food fishes of the nation. In 1880 Earl discovered that one of its chief breeding grounds was the Chesapeake Bay. It lays its eggs in the summer, each female depositing from 20,000 to 60,000 eggs. They are so small that there are 20,000 in a cubic inch. They float upon the surface of the water until hatched. The chief supply of our bay mackerel are caught with gill-nets or trapped in pounds.

We might say much more about the many other good fishes of Maryland: the perch, the bass, the trout, etc., but our paper is getting lengthy and we do not want to become tiresome. Many other varieties of choice and commercially valuable food fishes abound in our waters, famous as well for their extreme delicacy as for their abundance: the fine blue fish of the coast, the sea trout and striped bass, pike, white and yellow perch.

Too much cannot be said in praise of the Chesapeake Bay and the rivers of Maryland, of the great opportunities for development and for the increase of the wealth of our people from the fisheries.

We have these splendid natural resources, and we hope and believe that the time will soon come when Maryland shall take her proper place in the great work of the artificial propagation of fish.

Our Fish Commission is not so old as some, nor has it the means at command for investigation, research and experiment, which it needs, but we believe that in the near future the people of Maryland will fully realize the great and growing importance of this great work, and that all necessary money will be appropriated for the work of the Commission to give it the place its importance demands, and that the fisheries of our State will then be second to none among the great fish producing States of the Union; that then the large and valuable water area will be a far greater producer of wealth for our people than at the present time. We must have a great ad-

vancement in fish propagation and proper laws rigidly enforced for the protection of our valuable fisheries.

REMARKS FOLLOWING PAPER OF MR. GEORGE.

Mr. Dickerson: I would like to ask if you have any trout hatcheries?

Mr. George: There is one hatchery at Druid Hill Park, Baltimore, propagating brook trout and rainbow trout. We have put out more than five hundred thousand of these this season. We have also experimented with black bass.

Mr. Dickerson: When is your open season for trout?

Mr. George: We can catch them in April, May, June and July. The rest of the year is closed season.

Secretary Whitaker: Have you many trout streams in the State?

Mr. George: Yes, in western Maryland. Not many on the eastern shore.

Mr. Gunckel: I wish to state I have to return early this evening, and I would like to say that my home is at Toledo, Ohio, and any time any of you gentlemen are stopping in that little town I should be very glad indeed to have you call and see me. We have good fishing all around there and I will surprise you how I can catch fish. You gentlemen who have fished up in northern Michigan have your thousands of fish, but when you come there I will show you how you can catch fish where you can not see any, where there are no fish.

On motion, duly seconded, meeting adjourned until eight o'clock in the evening.

EVENING SESSION.

At the evening session Hon. J. W. Titcomb gave his lecture on "Photography and the Stereopticon in Fish Culture," with illustrated views with the stereopticon, after which the meeting adjourned until Thursday at 2 o'clock.

PHOTOGRAPHY AND THE STEREOPTICON IN FISH CULTURE.

BY J. W. TITCOMB.

"How are the little fishes?" "How are things going at the hatchery?" "Is this a good day for the fish?" and many other questions both relevant and irrelevant greet the ears of a fish culturist daily. The inquirers are frequently persons who know nothing whatever as to what the hatcheries of the country are doing nor their necessities. To one inquirer I recently made reply, "The fishes are doing first rate; I have twenty bantam hens sitting on brook trout eggs." Although more than ordinarily intelligent, my friend did not get around to question my statement until the next time I met him, when he wished to know if it is a fact that trout eggs are hatched under hens. The comparatively few who visit the hatcheries are surprised to learn that so much is being done by the States and United States to restock, or to keep stocked, the waters of the country which have become depleted of fish from many causes. They are surprised to learn that nature is so lavish in the reproductive powers of fishes but that she is so wasteful in caring for the spawn and fry of the parent fish; that while ninety and nine can be saved by artificial propagation, only one little fish comes to maturity in nature's folds. The professional fishermen often knows little about the habits of fish other than those which will contribute to his success in catching them, and from him most mistaken ideas of their habits originate.

As ignorance on any subject begets scepticism prejudicial to its interests, so the development of the fisheries by artificial propagation has often encountered opposition from legislators. It is the same ignorance which often opposes protective laws, drafted with special reference to the habits of the species protected. The objects of this society are usually carried out to the extent of reading papers upon relevant subjects, followed by a discussion of them. The benefits derived are many and are a source of profit and interest to the members and, through publication, to interested persons outside of

the society membership. But they do not reach the masses. To do this, a means of interesting the people is suggested by illustrating the fisheries and the methods of artificial propagation. The camera is in almost every household; the means of obtaining proper illustrations are thus made simple. From appropriate photographic negatives lantern slides can be obtained at a reasonable cost in any large city. Many amateurs and camera clubs are doing this kind of work very successfully.

The illustrations presented tonight are merely suggestive of what can be accomplished. Any attempt to illustrate the work of the United States and the various State Fish Commissions in the short time at my disposal would be misleading. To go into details about the various pictures presented upon the canvas before a society of fish culturists and scientists would be presumptive. I will, therefore, ask you to view the subjects thrown upon the canvas as merely suggestive. I have used them in my own State to instruct the people as to what is being done within its borders and, at the same time, let them see of how little importance is our work compared with the work throughout the United States. I strive to show them the importance of fostering the resources which they now enjoy and which would be completely annihilated in a short time were it not for artificial propagation.

As Vermont is the natural home of the brook and lake trout, the black bass and (by introduction) the land-locked salmon, the propagation of game fishes naturally engages her attention more than the development of her commercial fisheries. Vermont's fishery resources are being developed for the purpose of attracting the summer tourists and thus the propagation of the game fishes is a profitable business proposition.

I will first illustrate trout culture as conducted by the U. S. Fish Commission in Vermont:*

To illustrate trout culture, photographs of field stations where the wild trout are captured and the various methods of capture are interesting. A photograph of the natural spawning bed makes an instructive picture. An explanation of how this was obtained will enable others to repeat the experiment successfully. This photograph represents a spawning bed of the wild trout in three feet of water near the shore of a lake. It is necessary to exclude the light between the lens and the surface of the water in order to secure a good photograph. A crockery barrel inverted over the bed with lens exposed through a hole in the inverted bottom was used. The barrel

* (Foot Note.—The preceding is Mr. Titcomb's opening address, which was followed by 100 lantern slides briefly explained. What follows is designed for printing in the transactions of the society as a suggestion to those who would take up similar work but suited to the needs of the communities where the illustrations are to be explained.)

reached just below the surface of the water and the light which reached the camera came through the water itself. A better arrangement and one easily transportable can be made by a four-legged stand as a substitute for the usual tripod surrounded by a skirt of black cloth; the cap to be arranged with a hole in it through which the lens can be exposed. A bag of cloth around the cap can be drawn around the camera and held in place with a rubber band. Although the trout had left the bed when this exposure was made, I believe it possible to photograph them upon their beds another season.

Sorting and stripping fish makes another interesting illustration, with accompanying explanation of method of fertilization, etc. Various methods of eying eggs in stacks or as laid down in the hatching troughs can be easily photographed. Methods of packing eggs for shipping long distances can be illustrated and explained. In fact, all the details of a hatchery can be easily illustrated. The fry in their various stages of development make very attractive illustrations. In order to get good photographs of the fry in the troughs, or other trough work, a rude stand can be made to fit the troughs so as to sustain the camera with the lens in a vertical position facing directly into the troughs. The focal distance can be adjusted by having several auger holes through the back of the stand which supports the camera. The photographs can be taken by either flashlight or daylight. Daylight produces the most successful results for most of these pictures.

Fry monstrosities interest people and can best be photographed by placing them upon a glass plate with a white background a few inches below the glass. Some of the enemies of fish spawn naturally deposited and resultant fry can be photographed the same way. It is desirable to impress upon the people the reasons why artificial propagation is such a great improvement over the natural methods of reproduction. In fact, if all the spawn of all the fishes in the waters of our country hatched and became fishes, the time would soon come when there would not be sufficient water to sustain them. If salmon work is to be illustrated, similar photographs can be taken, together with methods of collecting the spawning salmon. Views of salmon actually leaping a falls 18 feet high, some of them showing the fish entirely out of water, are especially interesting. These were obtained by borrowing negatives from sportsmen from which to make the slides.

The comparative size of different fish eggs and fry contemporaneously hatched make a good illustration. Pike perch fry make a very good picture in contrast with trout fry. This picture is taken by placing the objects upon a glass plate with light colored background below the plate. Pictures of rearing

ponds and troughs, fingerling fishes, adult fishes, adult fishes of different varieties in comparison, *all* contribute to knowledge of the people. Methods of transportation of fishes, methods of feeding fishes, both young and adult, can be illustrated and explained. A live food box or "odorless maggot box," which can be used on ponds both artificial or natural, where artificial food is required, is here described in detail, because I have never seen anything like it before. The object of this box is to have a receptacle for waste meat, which, when properly charged with fly larvae, can be placed in a floating box tightly closed with a cover whose lids extend down into the water. The bottom of the meat trays in the box are covered with coarse wire cloth, the odds and ends of old hatching trays. Excelsior or straw is placed in the trays and then the fly-blown meat laid on it. As the maggots hatch out, they clean themselves in working through the excelsior and drop into the water where the fish lie in wait for them. The parts of this box consist of an outside frame which is merely a box without a top or bottom placed upon floats. Two movable trays are fitted into this frame on cleats, side by side. Two small trays are used instead of one large one, so that the meat can be renewed alternately, thus keeping a constant source of supply of larvae.

In illustrating the commercial fisheries of the country, their importance can be explained by deductions from the following table:

Statistics of the Commercial Fisheries of the United States.

States.	Persons employed.	Vessels.			Boats.		Other property.	Total investment.	Products.	
		No.	Net tonnage.	Value, including outfit.	No.	Value.			Pounds.	Value.
Alabama.....	1,193	53	522.18	\$50,945	541	\$16,372	\$112,359	\$179,676	6,566,781	\$906,837
Arkansas.....	4,750	66	9,703.57	1,151,685	561	7,917	235,647	235,654	3,675,886	116,011
California.....	3,047	206	3,260.68	1,682,282	1,353	19,610	1,305,367	2,830,834	50,068,531	1,274,729
Connecticut.....	2,392	42	554.00	37,854	953	98,598	2,065,387	2,830,834	6,483,721	1,214,571
Delaware.....							330,616	407,819	8,831,797	24,488
Florida.....	6,143	185	2,804.76	470,068	2,148	150,348	680,001	1,300,417	33,963,234	1,065,398
Georgia.....	1,869	51	641.80	28,833	680	20,277	235,754	284,864	4,093,100	170,805
Idaho.....	57				30	540	1,835	2,375	235,058	11,929
Illinois.....	2,656	4	116.77	18,495	1,694	56,064	929,693	1,004,252	12,631,565	371,410
Indiana.....	919				890	8,546	23,292	31,888	2,746,383	131,567
Iowa.....	944				789	14,797	31,913	46,710	4,079,704	124,851
Kansas.....	537				671	10,172	35,319	51,111	3,152,327	1,022
Kentucky.....	1,000	61	305.82	41,646	639	10,172	25,319	35,461	2,272,885	90,580
Louisiana.....	5,666	61			4,307	249,477	256,629	588,752	23,570,801	906,590
Maine.....	14,129	408	13,136.67	813,752	5,920	237,469	1,836,572	2,869,793	121,700,390	2,226,306
Maryland.....	42,812	1,419	23,670.00	1,344,542	10,077	562,455	3,914,613	5,821,610	88,588,018	3,617,306
Massachusetts.....	17,228	636	59,259.30	4,639,168	3,494	254,033	8,352,028	13,245,229	301,349,331	7,531,194
Michigan.....	3,351	64	1,390.87	326,928	1,673	103,689	1,243,551	1,674,168	34,019,915	964,279
Minnesota.....	1,075	2	296.52	42,400	703	44,463	181,649	298,512	7,307,165	185,649
Mississippi.....	2,962	83	854.88	107,063	605	20,500	405,307	532,870	10,045,755	246,392
Missouri.....	575				593	11,221	23,984	44,905	3,821,654	110,786
Montana.....	76				521	2,167	2,167	2,729	3,616,036	4,165
Nebraska.....	39				30	600	683	683	4,491	3,450
Nevada.....	365	15	588.05	43,009	73	4,170	65,391	112,660	3,956,824	9,461
New Hampshire.....	10,467	629	7,879.22	873,822	5,618	387,491	1,170,167	2,437,480	73,297,434	3,646,382
New Jersey.....										
New York.....	14,052	665	9,409.40	1,011,109	6,879	401,886	4,374,140	5,786,935	176,049,938	5,045,560
North Carolina.....	11,945	174	1,879.23	151,375	4,378	201,769	884,125	1,217,209	63,857,457	1,301,929
Ohio.....	2,353	59	797.26	223,432	967	117,876	1,840,650	1,681,958	30,194,846	567,039
Oregon.....	6,323	23	468.07	51,009	2,022	212,925	2,370,478	2,637,412	38,141,632	1,282,093
Pennsylvania.....	2,301	55	871.00	143,375	598	54,405	1,686,986	1,894,766	18,469,107	480,620

Statistics of the Commercial Fisheries of the United States.—CONCLUDED.

States.	Persons employed.	Vessels.			Boats.		Other property.	Total investment.	Products.	
		No.	Net tonnage.	Value, including outfit.	No.	Value.			Pounds.	Value.
Rhode Island.....	1,757	69	1,484.79	\$223,735	651	\$92,743	\$733,700	\$1,090,178	127,955,475	\$935,144
South Carolina.....	2,139	16	282.93	15,742	1,096	34,690	124,532	174,354	5,296,446	210,456
South Dakota.....	121	—	—	—	97	34,698	1,973	2,911	410,620	13,391
Tennessee.....	520	—	—	—	446	4,879	25,324	30,203	2,445,391	82,562
Texas.....	1,199	45	508.81	51,684	686	77,911	107,901	237,496	7,174,550	286,610
Utah.....	630	—	—	—	90	1,175	10,560	11,735	1,230,124	37,479
Vermont.....	169	—	—	—	56	1,060	3,704	4,794	208,139	7,100
Virginia.....	28,216	1,055	15,218.00	914,824	10,302	463,276	1,481,498	2,891,596	277,627,465	3,167,896
Washington.....	6,212	59	1,420.56	160,384	2,646	170,155	1,661,930	2,024,469	59,079,327	1,401,433
West Virginia.....	67	—	—	—	51	2,630	1,448	4,075	102,021	8,701
Wisconsin.....	2,371	41	664.06	104,062	956	50,584	555,986	770,864	21,966,073	529,416
Total.....	204,601	6,387	160,101.50	\$13,739,313	70,722	\$4,312,517	\$38,691,656	\$56,773,468	1,689,389,387	\$41,143,240
Alaska (estimated).....	6,410	89	28,698.00	897,000	1,151	148,620	3,637,060	4,682,680	88,480,394	*4,053,011
Grand total.....	211,011	6,476	188,799.50	\$14,636,313	77,873	\$4,461,137	\$42,328,716	\$61,456,168	1,777,869,591	\$45,196,250

* This represents in most cases the market value of prepared products, as canned salmon, etc.

The work of the United States Fish Commission can be referred to in this connection: For the years 1897-1898, thirty-six varieties of game and food fishes were propagated, and the distribution of fish and eggs amounted to 860,206,677. The table of distribution for 1898-1899 has not yet been completed, but I am informed the output will exceed one billion.

Views of various hatcheries about the country and the work they are accomplishing, methods of hatching different varieties, etc., etc., will interest and instruct the people. If game is a matter of interest in connection with the fisheries of a community, a few slides on wild game will add to the interest of the audience and, at the same time, an opportunity is given to illustrate why game must be protected and why game, except in a few instances with species of game birds, cannot be artificially propagated more successfully than by the natural methods, as is the case with fishes.

Having interested and instructed the people as to the necessities for artificial propagation of fish or for the protection of game, the natural sequence should be that the representatives of the people, voicing public sentiment, will act favorably upon legislation furthering these objects.

Perhaps I ought to add here that the preparation of negatives from which suitable slides can be made is not so easy as to secure ordinary negatives of scenery or even of interior views. The work involves more or less experimenting when strictly fish cultural slides are wanted, although for views of hatcheries and the illustration of the fisheries in general negatives can usually be borrowed. The writer has had especial facilities for obtaining photographs and negatives, in that one of his employes, Mr. A. H. Dinsmore, is not only a good photographer, but can make first-class slides.

AFTERNOON SESSION, SECOND DAY.

The meeting was called to order by the president at 2 p. m. Secretary Whitaker: I have a paper here on "Fish Culture in North Dakota," by W. W. Barrett.

On motion, duly seconded, the same was ordered read by title and to be printed in the report.

FISH CULTURE IN NORTH DAKOTA.

BY W. W. BARRETT.

Church's Ferry, N. D., June 6, 1899.

To Members of the American Fisheries Society:

Fellow Workers—I regret that circumstances will not allow me to be present at your meeting at Niagara Falls on June 28th and 29th, and enjoy the amenities and intelligent thoughts of the assembled scholars, who constitute the American Fisheries Society, but as I feel a deep interest in the propagation and culture of fish, I will present in this form, something in regard to this subject as it pertains to North Dakota. In order not to consume too much of the valuable time set aside for your deliberation, I will give but a brief letter.

PIONEER WORK IN FISH CULTURE.

North Dakota is a young State, and as yet limited as to the matter of State revenue, hence it has not established a State fish hatchery, neither has it made any appropriation to carry on the work of fish culture. But for the last ten years the Department of Irrigation, Forestry and Fish has been established and in successful operation, and during all this time the duties thereof have been entrusted to the care of the writer. Fully alive to the importance of making a success of the increase of fish in our State, I have taken active measures and been enabled to secure, mainly from the United States Fish Commission, a generous supply of fish for our waters, and the outcome has been most favorable in the enlargement of the amount of this species of food.

THE HOME FISH CULTURE SYSTEM.

For many years I have advocated what I term The Home Fish Culture System. It embodies these features: The cre-

ation of artificial ponds by holding back, by means of suitable dams, the flow of water in creeks, from springs and artesian wells (we have over seven hundred flowing artesian wells in North Dakota) and the creation of reservoirs by excavations in the ground, and the filling of the receptacle from common water wells, the water being lifted by means of wind and other power.

At first the system was looked upon with indifference and some opposition, but being based upon what seemed good sound principles and having been made practical in many parts of our State for a series of years, its advantages are now conceded. Through this plan numerous farmers are now raising large quantities of fish, and many more will try the experiment as soon as the supply can be obtained from the writer or elsewhere. Two years ago I furnished five thousand (5,000) lake trout fry to a farmer living near Oakes, N. D. He planted them in an artificial pond made by damming up the waters from a spring upon his farm. A few days ago I received a letter from him. He is very enthusiastic and much delighted because his fish raised from the fry are most plentiful and measure from ten to twelve inches in length—speckled beauties affording rarest sport, as they take the bait most readily.

The benefits attending the carrying out in practical detail of the Home Fish Culture System demonstrate it contains true merit, and is worthy of studious attention, as it indicates fish culture, at a small expense, can be made a profitable factor in diversified farming or rural life. It has many desirable advantages, some of which I here mention: It is an inexpensive system; under proper management, it is certain, as a rule, to supply a large amount of cheap and nutritious food for the family; it can be made a source of revenue, if desired, by sales of the fish, and what is a most desirable feature, no person has a legal right to take the fish without the consent of the owner. Besides all these profits, the fish are near at hand, so the pleasure of angling can be indulged in at any time and fresh fish had for the table when desired, and the culture of the finny tribe at the home place is most fascinating and instructive to the family, especially to the young studying the works of nature in beautiful development.

It is gratifying to know the interest in this home fish culture system is constantly increasing in our State.

I am also, thus far, meeting with the best of success in my experimentations with the raising of fish in artesian water.

This pioneer work of fish culture in North Dakota is being carried on under the most adverse circumstances, the principal difficulty being there is no appropriation made by the State to cover the expenses, but the results are most encouraging and

it is reasonable to suppose they will lead to some tangible action by which our State will be made to take a front rank in the matter of artificial fish culture.

The work of the American Fisheries Society is worthy of the fullest commendation, as it deals in an intelligent manner with vast economic problems involving the material welfare, support and comfort of the people throughout the Union. I cannot but trust your deliberations at this meeting will be attended with interest and profit to yourselves, fitting for large usefulness in the great and important work assumed by the association.

Respectfully yours,

W. W. BARRETT,
State Fish Comm. of N. D.,
Church's Ferry, N. D.

Mr. Titcomb: Mr. President, the success of any organization of this kind usually depends upon the work of one man, and I think as a rule it has been the Secretary in this Association. In recognition of the services of Mr. Whitaker, who retires from office at this time, I move a vote of thanks of the Society be extended to him for his services during the past two years. I am sufficiently familiar with the running of such organizations as these, and in filling such offices, to know that the Secretary has much work to do, and I therefore move that the Society extend to Mr. Whitaker for his services a vote of thanks.

Mr. Bowman: I second the motion.

The President put the question and the same was unanimously carried.

Secretary Whitaker: I would like to say just one word in this connection. There is only one thing that would have induced me to take the office of Secretary in a society like this. For years we were having proceedings regularly taken and we were not getting them printed and in the hands of members until sometimes within a month or two of the time of the next meeting. I took the office for the simple purpose of demonstrating that the thing could be done, and it has been done.

President Peabody: Professor Reighard is the only author of a paper who is present at this session, and as some of the gentlemen are going to leave on an early train, if there are no objections, I think it would be best to have Professor Reighard read his paper at this time.

A PLAN FOR THE INVESTIGATION OF THE BIOLOGY OF THE GREAT LAKES.

BY PROFESSOR JACOB REIGHARD.

It is not necessary for me to point out in detail to an assembly like this how little we really know of the life in our Great Lakes. We do not know fully the life history or the food habits of any one of the commercial fishes. Much less do we know of the life history, food habits or breeding habits of the many animals and plants that surround these food fishes and upon which they are dependent.

In spite of this we are necessarily at work having laws made for the control of the fisheries. We are, perhaps also necessarily, spending large sums in artificial propagation. All this we are doing without any adequate knowledge of the materials with which we are at work.

It may be said that this, which is true of the fisheries, is true also of many other undertakings; that the physician knows very little of all that is to be known of the physiology of the human body—very little of all that is to be known of the action of remedies on that body—but that in spite of this, his work is, on the whole, of value. Like statements may, with entire truth, be made about many other lines of human activity. What we really know, compared with what we might know, is but little in any direction. But let us assume that we know as much of all that it is possible to know of the conditions of life in the Great Lakes as the physician knows of all that might be known of the human body. And yet the physician, without complete knowledge, often indeed with very little knowledge, reaches results, while the student of the Great Lakes has yet to prove the benefits of either legislative or fish-cultural doctoring.

The reasons for this are not far to seek. In most affairs of life we learn by experience what measures bring the desired results. The physician has abundant opportunity to test his medicines and to bring his tests to a speedy conclusion. He has most often learned what is good, not by scientific induction, but by experience. In other words, the art precedes the

science, practice comes before theory, and this is usually true of human affairs. In the lake fisheries, matters have taken the same course, and, so far, without demonstrable success. We must, it seems to me, seek the explanation for this lack of success in two conditions.

In the first place, the problem of the lakes is so vastly complicated that it is difficult for the student or scientific man to even guess, in the present condition of knowledge, what should be done toward the solution of any fisheries problem. In the second place, it requires a great length of time and large sums of money to learn by experience alone what is necessary. To put the matter in another way, we have not the data at hand from which to decide inductively what it is best to do in any given problem of the lakes—while, on the other hand, we have not, as yet, had either time or money to find out, as the physician usually does, by the cut and try process—that is, by simple experience, what it is best to do.

The question then seems to me to be, since the fisheries problems of the lakes are unsettled, whether it is best to spend money and time in trying to settle them by experience, ignoring other methods, or whether it is best first to determine scientifically the factors entering into our problem. Personally, I believe that in this matter progress by experience is, to an unusual degree, a matter of chance, like hunting for gold. It is costly, time-consuming and dangerous, and may lead to nothing or worse. On the other hand, to investigate the biology of the lakes is to make progress toward the solution of the problems of the fisheries. This progress may be slow, but it is, in the very nature of things, certain. I believe that such scientific investigation has become a necessity to further progress.

If this be granted, it will at once be asked by those whose aims are practical, whether it is not enough to investigate practical problems as they arise. It may be granted that the failure of a certain fishery or the prevalence of disease among certain fish is a matter demanding scientific investigation, and yet it may be thought that any more extended investigation is a matter that does not really concern the fisheries, and that may, therefore, properly be left to the unaided efforts of men of science. Those who hold this view should not forget that the inhabitants of the lake are so intimately related to one another and are so directly influenced by the physical conditions of the lakes that a consideration of any one of these things is not merely likely, but almost certain to involve the others. An investigation into the causes of decrease in the whitefish may involve a study of the chemistry and bacteriology of the water or of the physical properties of the under-

lying soil. Is it not better, then, to enter at once upon a study of as many as possible of the elements that are likely to enter into the practical problems that now confront us or that may confront us? Is it not better, in other words, to take up the study of the biology of the lakes from the point of view of pure science for the purpose of finding out as far as possible the facts and of making clear as many as possible of the principles? Then when, in the future, any fisheries problems arise, the facts and principles for their solution will have been already in large part determined. Such a course does not preclude the immediate investigation of certain pressing problems of interest to the fisheries. It does bring into prominence the fact that such investigations are not in themselves sufficient, are likely to be inconclusive and can in no sense be considered final.

There is still another reason why it seems to me that the investigation of the lakes may best be undertaken on a purely scientific basis without direct and necessary subservience to the fisheries. We have had almost within my memory two distinct phases in the evolution of natural history subjects. During the first of these the principal aim of botanists and zoölogists was to collect and name as many species of animals and plants as possible. That man was considered the greatest zoölogist who could repeat correctly the Latin name of the largest number of animals. I do not wish to underestimate the value of such knowledge. It is necessary preliminary knowledge. I wish merely to point out that it is not of the greatest use to the fisheries. While any work, of whatever sort, that is done in the lakes must take account of the systematic names of the animals and plants of the lake and of their distinctions, I am unable to see how a science devoted largely or exclusively to such knowledge can greatly benefit the fisheries.

During another phase in the development of natural history, a phase in which we still are, attention was turned to the anatomy and development of animals and plants. Zoölogists believed that animals were related to one another, that a process of evolution produced one from another and that by a study of the structure of these animals their relationship to one another could be discovered. This hope is being largely modified or abandoned. Zoölogists are indeed convinced that evolution has taken place, but just what the resulting relationship is that obtains among existing animals is largely a matter of speculation or of personal opinion. Again, in this phase of the development of zoölogy and botany it seems to me that the interests of its students are not along lines that are of great use to the fisheries. It is of course true that a knowl-

edge of the anatomy, development or relationship of an animal is very likely to be of use in the discussion of fisheries problems, but it is equally true that so long as a science makes such knowledge its chief aim, largely to the exclusion of other knowledge of animals, it fails to give to the fisheries the aid of which it is capable. I doubt if it can be shown that the fisheries have ever been directly benefited by either anatomical or systematic studies.

Naturalists are now becoming convinced, since evolution is taking place under their eyes, just as it took place in the past, and since the same forces that have in the past been at work modifying animals are still at work, that these forces must be studied. Although these forces lie largely in the environment of animals, the most important thing is neither the animal nor its environment but the relation between the two. For an intelligent understanding of the subject of evolution naturalists want to know all about the conditions under which animals live—about their habitats, their food, their enemies, their parasites, their rate of growth, their daily habits, their length of life, their rate of increase, their breeding habits and many other things.

The things that are thus again coming to interest zoölogists are precisely those that are important to the fisheries. When a few years ago the regular scientific work of naturalists was, as it still is, largely anatomical, developmental and systematic, it was of only secondary interest to the fisheries. Now that such work is changing in character it is likely to furnish the very materials that are most needed for a full understanding of the fisheries.

I thus find two principal reasons why, as it seems to me, a broad investigation of the biology of the Great Lakes, undertaken from the point of view of pure science, is likely to prove of more value to the fisheries than a series of minor investigations undertaken for the purpose of solving isolated practical problems. The first of these reasons is to be found in the complexity of the conditions existing in the lakes, making the investigation of isolated problems from a purely practical standpoint unusually difficult and likely to result in failure. The second reason lies in the present trend of natural history studies, so that the facts of interest to the man devoted to pure sciences are the very facts which have value for the fisheries. Other reasons might be cited for investigations along purely scientific lines, but I shall confine myself to these two.

If, as I believe, it is best for the fisheries that an investigation of the lakes be undertaken from the point of view of pure science, it remains to ask how such investigation may best be carried on.

I shall try to answer this question categorically:

1. *Investigations should be carried on throughout the year.* So long as animals were merely to be named or their anatomy studied it was sufficient to collect them during the summer and to preserve them for work during the winter following; but when it becomes necessary to study the habits of animals over long periods, their rate of growth and other similar questions, the observations must of necessity extend over long periods of time, sometimes over many years, and summer work alone no longer suffices.

2. *The work must be done by a permanent staff of investigators.* The problems of the lakes are not to be solved in a day nor in a year. They will require the continuous labor of many men for many years. I presume that the unsolved problems of agriculture are as numerous and as pressing as ever in spite of the army of men that has for many years been at work upon them. It is the same with the fisheries. In twenty years some of their problems may be settled but there are sure to be others quite as pressing. At present most of the scientific work relating to the fisheries is in the hands of college or university teachers who spend at it their summer vacations and such time as they can spare besides. Such a condition of things can be only temporary. Professor Birge has very well said: "With all due respect for the college professors, I don't think they can do that work permanently." The men who do the work must have time to think about their problems, they must live with them, day and night, year in and year out. Time and a high order of ability are needed and these must be well paid. There is of course work that can be done by college men during their vacation time and arrangements should be made for their doing such work. My criticism here is not that college men are engaged in this work but that they are engaged in it to the exclusion of others. Their part should be secondary, whereas it is now the principal part. Any plan for the investigation of the lakes should include arrangements whereby college men and others, not regular members of the laboratory staff, may be provided with facilities for carrying on their investigations. These facilities should be provided without cost, and in certain cases investigators from the colleges should be encouraged by financial aid and by other means to carry on their investigations in connection with a central laboratory. Thus, in addition to a permanent staff of investigators, there should be a subsidiary staff drawn largely from among university and college teachers.

3. *It follows that a permanent laboratory needs to be established.* Such a laboratory should be located if possible near both deep and shallow water. It should be upon the shore of one of the Great Lakes, but at the same time upon a good

stream of clear, cold water and not too far from diversified inland lakes. It should have workrooms for investigators, an abundance of large and small aquaria, with suitable appliances for furnishing air and water. It should be equipped with all the modern appliances, with microscopes and other optical apparatus, and especially with experimental apparatus. There should be rooms for chemical work in charge of a competent chemist. There should be a physical laboratory suitably equipped. Photographic rooms and photographic appliances are necessary. A mechanical workshop with a skilled mechanic who can construct and repair apparatus is also a necessity. Other things will doubtless occur to him who undertakes to prepare detailed plans for such a laboratory. Near the laboratory there should be breeding ponds of various sorts so arranged that the temperature of the water may be regulated.

In connection with such a laboratory it is necessary that there be a *movable laboratory of some sort*. Possibly a steamboat fitted up to be used as a laboratory best serves this purpose. In place of a steamboat a small laboratory building that may be taken to pieces and again set up in another place may be used. Such a portable laboratory could be quickly moved from place to place for scientific work or for the investigation of any problem of the fisheries that might arise. It is a necessary adjunct of the central station.

4. *Whatever the location selected for the central station, it should be easily accessible* at all seasons of the year and from all parts of the country. This is so obvious an advantage that it scarcely merits further discussion.

5. *It seems to me that work such as is here described should be carried on in some relation to a university.* Universities are the centers in which scientific work is most cultivated. Aside from the city of Washington they may be said to be the only centers in which such work is cultivated in this country. The individual worker is there stimulated by contact with fellow workers, and his results and ideas are tested before publication by being subjected to the criticism of his fellow workers. These are advantages not enjoyed by workers in isolated institutions. For these reasons it seems to me that some relation should exist between such a scientific institution as I have described and some neighboring university. As to what precisely should be the nature of this relation, I do not at this time undertake to say.

I have sketched this plan in outline only. The details remain to be considered and filled in. Many of them can be suggested only as the result of experience, but a plan something like this seems to me to afford the best chance to reach lasting

results in the many problems that concern the fisheries. I have brought this plan forward here in skeleton form in the hope that it might provoke discussion. I shall be very glad of any suggestions or criticisms either public or private, and can assure you that they will be of assistance in defining and developing the plan.

DISCUSSION OF PAPER OF PROFESSOR REIGHARD.

Mr. Clark: Mr. President, it seems to me that we ought not to let this paper pass without some thought in connection with it. It impresses me that it is a vital thing—the question of the study of the fisheries in the particulars referred to by Professor Reighard. It is a subject that I am very much interested in, for one thing, because there are so many questions asked me in regard to what the fishes do. I am very frequently asked what the peculiarities of various fishes are in this direction and that direction. A question was asked me at dinner and I had to say that I did not know. As a fish culturist of twenty-five or thirty years standing, it is a little embarrassing to answer in that way, but we have to do it; there are so many things in regard to fish that we know comparatively little about, even in regard to the fish that we are hatching, and it is utterly impossible for practical fish culturists to investigate in that line. The points brought out by Professor Reighard, it seems to me, is where the great study today is, and very vital to the increase and success of our work.

Mr. Parker: Mr. Chairman, I was going to say that the writer's comparison as to the physician is a very happy one. The scientific physician and the empirical physician are entirely distinct from each other. The former mingles science and his practice together and is the one who gives us the best results. It seems to me that in connection with the fish interests the same rule will apply. It is science wedded to practice that is going to give us what is best and which will be of the most use, not to science alone, but to the practical interests of the fisherman. It seems to me that the plans outlined here, together with those which practical men can outline, would be of immense benefit to the country, not only to the Great Lakes, the work on which he has alluded to, but to the seashore, the doing of the work that is being done at Woods Hole and which Professor Bumpus told us about here yesterday. All of these things, it seems to me, go hand in hand, and it is for this Society to take these things up and see what can be done with them.

Mr. de Ravenel: I am obliged to leave in a few minutes to go to Buffalo, but I want to say I heartily indorse what has been said by both Dr. Parker and Mr. Clark in reference to Dr. Reighard's paper. There is no question at all, if we expect to get the best results from fish culture, we must bring in the biologist, and we must study thoroughly the conditions that surround the animals that we are attempting to preserve and propagate. In regard to the general lines Dr. Reighard has laid down, I must say frankly as a practical man that the expense involved in carrying them out would be very large, and I am afraid unless we make a much more modest start that it would be difficult to get Congress to enact the needed legislation. The cost of a vessel like the Albatross would be up in the hundreds of thousands of dollars, and the establishment of a complete biological laboratory and aquarium would make the cost of such a station a hundred thousand dollars. I am not speaking recklessly on that question. Your ordinary biological stations cost from forty to fifty thousand dollars without any of these attachments. I think that I am within bounds in saying that the Woods Hole station cost from sixty to eighty thousand dollars. I would like to ask Mr. Bowers if he knows about that.

Mr. Bowers: From sixty to eighty thousand dollars.

Mr. de Ravenel: I think, then, we would have to start off in rather a modest way, but in such a way that we can develop as the time goes by. I hope Professor Reighard will keep this matter agitated and that we will in a few years see a biological station established on some of the Great Lakes.

Mr. Titcomb: I will inquire of Mr. Reighard if he thinks a resolution of this Society, indorsing such a movement, would be of any special assistance.

Secretary Whitaker: We did indorse it last year. The matter was brought up and received the warm and hearty indorsement of the Society. It was quite fully discussed at the last session, and I do not think the Society has changed its mind since that time.

So far as the practical side of this question is concerned, my views were expressed very fully a year ago. The Professor well knows that Michigan undertook to do something of this kind, to investigate the conditions of plankton and of the larger forms of life in the Great Lakes, and also of their flora so far as that subject was related to the food fish and their supply of food. What we had in mind at that time was, of course, on very much narrower lines than is proposed in the Professor's paper, because of the very thing that has been suggested here—the lack of means would not warrant anything of that kind. I think that any one who has been

connected with fish culture, directly or indirectly for any length of time, appreciates the meagerness of our knowledge regarding the conditions in the Great Lakes affecting the life of the commercial fishes themselves. One of the things that I talked with the Professor about at the time we were carrying on these investigations was the desirability of definitely determining whether certain localities furnished more fish food than others, which had a practical bearing on the question of where fish should be planted. Of course, we take the ground, and it stands to reason, that where the fish deposit their spawn is the proper place to deposit the young fish with best chances of success. Presumably there is a food there for the young fish when they are hatched naturally.

There is another thing I think it would be interesting and of value to know, and that is when the emigration of the young fish commences from spawning beds? Do they change the character of their food as they grow older, and what are their movements during the year? There are many things that might be suggested as proper subjects for investigation. It seems to me, with the amount of money the United States Commission has at its disposal, while they have a great many channels into which it can be turned, that a station equipped with buildings of reasonable cost which would answer the purpose and arrive at the results, might be established without an extravagant expenditure of money. A fitting illustration of this idea was presented by our friend Titcomb last night in his lecture. He showed us a cheap station where he has accomplished nearly the same results as the St. Johnsbury, and I should presume, from the looks of the picture, that the cost was much less than that of the St. Johnsbury station. I hope the matter will not be dropped, but that means may be found by which Professor Reighard's plans can be carried out.

Mr. Reighard: You asked me whether I thought it would be an advantage to the Society to take some action in regard to this. It seems to me it would. You gentlemen have much more experience in such matters than I have, but it seems to me that a resolution passed by the Society, or perhaps the appointment of a committee by the society, would aid very materially in furthering this plan.

Secretary Whitaker: Action was taken last year. I had forgotten about it when you spoke to me about it some time ago; but this idea was fully indorsed last year and a resolution was passed asking that it be carried out.

Mr. Clark: The idea of the Professor now is, to have a committee appointed to formulate a plan in the line of a permanent station.

Mr. Reighard: I say, Mr. President, I do not know much

about how this Society works, I am only recently a member of it, but I should think a committee could do something, not merely in formulating plans, but to hold itself ready to do whatever would be necessary, provided the Society wishes to commit itself to this plan.

President Peabody: To bring about the desired result, I should think that the fish commissions of the states bordering on the lakes might take up this matter jointly and use their influence with their members of congress to secure an additional appropriation for this purpose. It seems to me that is the practical way to arrive at it.

Secretary Whitaker: I addressed some letters to Congressmen and Senators from our state, last year, on this subject. I should fancy from the remarks of Mr. de Ravenel, who, I presume, speaks with authority, that what is to be done has not yet been fully determined. I presume this is all tentative, but until the United States Fish Commission determines what it is going to do in the matter it might be a loss of energy to do anything further with it. It has had our indorsement. I am not particular about it, but merely make that as a suggestion.

Mr. Titcomb: It is my impression the United States Fish Commission is ready to do anything they possibly can when they have the money to do it. I think that is the idea we have obtained from the present Commissioner. Now, if this Society can do anything, can add any influence by offering a resolution at the present time, which might be of use to the United States Fish Commission in obtaining an appropriation, I think the Society ought to do it. And further, if it would be of any use for the Society as a society, through a committete appointed at this time, to use their influence with the representatives in Congress from the states bordering on the Great Lakes, to take hold and back up the United States Fish Commissioner in these matters, that the Society ought to do it. If it is the sentiment of the society that such a committee could be of use in organizing a movement along the lakes, looking to this result, I should be glad to see such a committee designated. I merely make this as a suggestion.

Mr. S. Bower: Mr. President, in order to bring this matter to a focus, I desire to make a motion. I move that Professor Reighard be invited to formulate a circular letter, which, when it is ready, and when the proper time arrives, shall be fathered by this Society and be sent out as emanating from this Society through its President. I think such a letter would have considerable influence, and a copy of it could be addressed to every member of the Society throughout the United States and to every fish culturist, and to everybody who is interested in the

fisheries; to our Congress and to our representatives in the State legislature, and to everyone who might be interested and willing to co-operate in bringing influence to bear upon Congress. In that way I think we might create quite a good deal of public sentiment in the matter, and directly or indirectly it might have a good deal of weight with congressmen, and when the matter was brought to their attention by the United States Fish Commissioner it might have a good deal of bearing upon the amount that they would be willing to allow for this purpose. I make this as a motion.

The motion was duly seconded, and the question being put by the President, the motion was carried.

President Peabody: I would like to ask the Commissioner, if five congressmen on the lakes should ask for an appropriation, if it could not be brought about?

Mr. Bowers: It would be necessary to ask for an appropriation for scientific inquiry. If I am not mistaken this Society took some action a year ago on this matter, and on my recommendation the appropriation was increased from ten thousand eight hundred to fifteen thousand dollars, and on account of the increase an opportunity was to be given for work on the Great Lakes, and this work is now being carried on under the direction of Professor Reighard. It has been my intention to recommend a still further increase for that division, and I have thought of asking this year for twenty-five thousand dollars, and from time to time to increase it as it can be done.

President Peabody: If that is backed up by the personal work of the congressmen it would be easily carried out, would it not?

Mr. Bowers: Yes, I think so; but, after all, it devolves upon this Society to bring such influence as it can upon its representatives both in the Senate and in the House, for if we have good appropriations we can do good work.

President Peabody: There would be no difficulty in Wisconsin or Michigan getting their influence. Is not that your opinion, Mr. Whitaker?

Secretary Whitaker: I do not think there would. Did not this Society a year ago make some recommendations on this line?

Mr. Clark: Yes, there was a resolution passed.

Mr. Bowers: And, as I have just said, on the strength of it in my estimate to Congress I asked for an increase in the appropriation from ten thousand eight hundred to fifteen thousand dollars. But that is a small appropriation. It had been ten thousand eight hundred dollars for fifteen years past, as I understand it, and this is the first year we have had as much as fifteen thousand dollars for this purpose. It is inadequate. It should be twenty-five thousand dollars. In the recommenda-

tions to be made by me in October, I am going to ask for twenty-five thousand dollars, and yet, on the other hand, if some of the representatives on the great lakes should ask for an appropriation for the establishment of a laboratory, it might possibly be got through in addition to the appropriation for scientific inquiry.

Mr. Clark: Special, do you mean?

Mr. Bowers: It would go in the sundry civil bill, you understand. It would be necessary to have a resolution passed authorizing the Commissioner to make the requisite investigation to determine on the location, and, really, we should have two laboratories, one on the coast of Florida and one on the Great Lakes.

Mr. Reighard: The sum you speak of, fifteen thousand, is the total available?

Mr. Bowers: For all purposes. At present we are running virtually three laboratories out of fifteen thousand dollars; one at Woods Hole, one at Beaufort, North Carolina, and one at Put-in-Bay. The amount is fixed by Congress. The statistical inquiry is given five thousand, whilst propagation and fish culture is given one hundred and fifty thousand. Of course, we have thirty or thirty-five stations to operate with that, and expenses of all kinds must be paid from that source.

This paper of Professor Reighard's gives some valuable information that would be useful to our commission, and I suggest, in view of the fact that it would be necessary to make a recommendation to the Secretary of the Treasury by the first of October, that I be furnished with a copy of his paper at the earliest possible moment.

Mr. Clark: I would suggest, that as soon as it comes to the Secretary's hands, he have a typewritten copy made and send it to the Commissioner. Ordinarily it has been the policy of the Society not to give out papers, but in this case the circumstances are different.

Mr. Bowers: I assure you I shall do everything in my power to bring about the recommendations made in Professor Reighard's paper. I am just as anxious to have a laboratory on the Great Lakes as any individual member of the American Fisheries Society, and you shall have my active co-operation and the support of the Fish Commission in these matters.

Mr. Parker: I suppose the paper read is a document of the Society, and I would move that it is the sense of the meeting that a copy be type-written and forwarded to the Commissioner of Fisheries; that the Secretary be authorized to have such a copy made.

The motion was duly seconded and carried.

Secretary Whitaker then read the following paper by Mr. Fred Mather:

THE GAMMARUS OR FRESH WATER SHRIMP AS TROUT FOOD.

BY FRED MATHER.

When I began breeding trout, something over thirty years ago, the gammarus was thought to be an all-sufficient food for trout of all sizes, and a beginner was advised to stock his streams with them and then watch his trout grow. This idea still prevails to a great extent, and because I do not value the gammarus as highly as formerly, this paper is written.

Trout from two to six months old live largely on the larvæ of the many species of water breeding insects, together with small crustaceans, such as gammarus, asellus, cyclops, etc., as well as mature insects. Such small food is quite "filling" for a troutlet, but a yearling is not entirely satisfied with such small morsels, and adds snails and small fish to its menu. When our trout is two years it looks for larger things, although a few flies, by way of dessert, are still alluring, while very large trout seldom rise for flies.

Last winter I wrote a book which is now being printed by *Forest and Stream*, entitled "Modern Fish Culture in Fresh and Salt Water, with chapters on the culture of Whitefish, by Hon. Herschel Whitaker, and on the Wall-Eyed Pike, by James Nevin." Perhaps a quotation from the chapter on natural foods for trout will cover my views on this subject. I have said:

"If the fish are to forage for the whole or part of their food, the pond should be stocked with such water plants as grow in spring water, and then the crustaceans, gammarus and asellus should be introduced. But beware of the burrowing crawfish, for it not only enters into competition with the trout for its crustaceans and insect larvæ, but makes holes in dams. Besides this, it cannot be eaten by small trout when it is in the adult state, and when soft it hides. The gammarus is usually called 'fresh-water shrimp,' while the asellus, or 'water asel,' looks somewhat like the 'sow-bug' found in decayed wood. In some waters these crustaceans grow to the length of three-

quarters of an inch, but usually they are smaller. Trout also eat newts or salamanders as well as snails, both the spiral and the ramshorn. Insect larvæ will be apt to breed in the ponds without being especially introduced. The gammarus is greatly over-rated as a trout food. A few are eaten, but not in the proportion that is usually thought. My searching of stomachs of wild trout under two inches long showed, under the microscope, that cyclops and Daphnia, two minute forms, barely visible to the naked eye, were the most plentiful.

"On Wilmurt Lake, situated on top of a mountain in Herkimer county, N. Y., where no fish but brook trout live, I opened the stomachs of 247 trout that had been dressed for the table. No microscope was at hand and there was much that could not be identified. From what was distinguishable a rough estimate was made. It was: Insects and their larvæ, 80 per cent; newts, 15; gammarus, 5.

"At Meacham Lake, Northern Adirondacks, the result from 138 stomachs was: Insects and larvæ, 60; newts, 5; gammarus, 5; fish, 30. Therefore, I feel warranted in ranking the gammarus low in the list of trout foods. Still, it has a value. Trout of a pound weight seldom eat it."

Since the book was written I have examined but few trout stomachs, but hope to continue the investigation. I am now in the northwestern county of Wisconsin, on the famous Brule River, where trout once swarmed, and a few are left; the aquatic fauna seems to be scant in species, although numerous in individuals, but I have been too busy to study it. The gammarus is reported to be found here, but I have not met it.

DISCUSSION OF MR. MATHER'S PAPER.

Mr. Clark: Mr. President, I do not agree wholly with Fred Mather. However, I shall not fill the book with any discussion in opposition to Mr. Mather, because he is not here; generally when he is we have a time, but I think the gammarus is a valuable food for trout, and I think that I can prove it right in Northville. I gave a little statement last year in regard to five thousand brook trout fry that were put in our spring pond, and the gammarus is the principal food of the spring. The trout lived four months without any artificial food. All the food they had was the life that was in the water, and the gammarus was the principal thing. They were put in the spring pond the first of June and in October they were taken out. And they actually counted thirty-six hundred and a little over of as nice, healthy trout as I ever saw.

Mr. Titcomb: Mr. President, I have not much to contribute on the subject of this paper, but in Vermont no self-respecting trout will eat a newt; they will eat the leach, the blood-sucker, but we have trout ponds stocked with trout where natural food is scarce, where the fish do not attain a large size on account of the lack of food, and the same ponds are teeming with newt. I have never found a newt inside of a trout. I have been aware they would occasionally eat them. I am surprised that they would in some places where they have so much other food, like the insect larvæ. As to the gammarus, I have very little experience except in some observations made in the commercial trout hatcheries of Mr. Gilbert at Plymouth. He has rather a crude station; that is, he has not kept up with the times in fish culture, perhaps, but in some ways he has accomplished a good deal with natural food. His ponds are teeming with the gammarus and the banks of the streams flowing into the ponds are teeming with the gammarus. You take a sod out of the banks anywhere and lay it down on the walk and it is alive with them. He claims that he gets a finer colored fish and a better flavored fish by getting so much natural food, and that his trout artificially reared can not be distinguished from the wild trout. He cooked some for me and I could not see but that they were just as good as the wild trout which I take out of the streams of Vermont. But certainly a large number of the fish were dependent upon the gammarus to sustain life.

Secretary Whitaker: I suppose there could not well have been much difference in the fish if the food was the same as the wild trout.

Mr. Titcomb: I do not suppose there could. He had really imitated natural conditions very closely.

Secretary Whitaker then read the following paper:

SOME NOTES ON THE MONTANA GRAYLING.

BY DR. JAMES A. HENSHALL.

My paper on the Montana grayling, read at the last meeting of the Society, contains some statements obtained at second hand which I wish to modify. My assistant engaged in collecting grayling eggs at Red Rock Lake, Montana, reported to me last season that the eggs when first extruded were quite adhesive, causing them to form in bunches, soon followed by a rapid development of fungus, which caused the death of the egg. When the eggs were received at Bozeman station they were clear, crystal white in color, which I gave as the characteristic hue.

I found this season, from personal observation, that the eggs when first extruded were of a rich yellow color, owing to the large oil drop, which renders them almost semi-buoyant; but after a few days of incubation they became quite pale. I also discovered that when first extruded the eggs were not at all adhesive, but if not exposed to a pretty strong pressure or current of water after fertilization (instead of being placed in the ordinary manner on flat trays), fungus soon formed, with the consequent adhesiveness and bunching of the eggs. This season we employed the hatching jar and the Stone-Williamson basket trays, instead of the flat tray, and had no trouble with fungus or bunching of the eggs, although we had but two feet fall of water from the reservoir trough. This proved the prediction made in my paper last year, that the eggs should be subjected to a strong current or pressure of water to obtain the best results; and this can be accomplished by the use of the hatching jar or the Stone-Williamson basket tray.

The grayling embryo is so active and lively, and the egg so buoyant, that there is a constant tendency to its floating off from the ordinary flat tray. This method is, however, still employed in England. In a letter recently received from Mr. Andrews, of the Surrey Trout Farm, Haslemere, England, he says:

"We find it an advantage when spawning the fish (grayling)

to avoid shaking the eggs in the pan more than we can possibly help—we usually spawn the fish direct into the perforated zinc trays (standing in the pans), in which they are to be hatched, and then after milting them and adding water we let them stand until they are ready to go into the hatching boxes.

“The tray with the eggs in it is then lifted out of the pan and placed in the hatching box. If very much fluid comes away from the female with the eggs, we drain this off before we add the milt from the male, and the water.

“Our hatching water is about 49° F. in temperature, and does not vary more than $\frac{1}{2}$ °. In this temperature the average time of hatching is about 22 days after being laid down, or half the time of trout ova. The alevins lose the sac very quickly, and at the first signs of feeding we sprinkle dry floating food, which we obtain from the dog biscuit manufacturers, on the water in the hatching trays, and they take this readily.

“After feeding for two or three days, and when they are taking the food well, we remove the fry from the hatching trays to a rearing box, where they are fed for about ten days in a similar manner, but they have in addition about two feeds a day of very finely chopped meat. We then turn the fry out into shallow ponds with a good stream of water running through them, or shallow streams; in all of these we have an abundance of natural food: shrimps, snails and minute crustaceans, water fleas, cyclops, etc. After turning out into these ponds and streams we do not feed more than twice a day with artificial food.

“We find grayling *much* more difficult to rear than trout; and in this country waters which suit trout do not always suit grayling.”

The eggs of the Montana grayling hatch in from 10 to 15 days in water of about 50° F.; and in shipping the eggs after the eye-spots appear, some will hatch en route if the temperature rises above 40°. For shipping long distances they should be placed in refrigerator cars or a specially devised shipping case prepared, whereby the temperature can be kept at 40° or a few degrees below. I shall endeavor to design such a case for future shipments to long distances.

All of our grayling eggs are subjected to a wagon haul of fifty miles over rough spring roads before reaching the express office—an untoward circumstance that can not be avoided at present.

We find that the liver or meat diet, in a fluid state, as used for trout fry, is the best also for grayling fry. Our newly hatched fry will not take dry floating food, as recommended by Mr. Andrews. We have tried baker liver ground very fine

and the fine fish cake, but they refuse to notice either, though they will take it after being taught to feed on liver emulsion.

The proper systematic place for the Montana grayling has not yet been definitely settled. During the past year the name *ontariensis* has been relegated and the former name *tricolor* has been restored, so that the present name of the Montana grayling is *Thymallus tricolor montanus* (Milner). Jordan & Evermann say it is: "Entirely similar to the Michigan grayling, but the dorsal a little smaller." This I can not subscribe to, as from examination of a large series of specimens this spring I find the Montana grayling to be as closely allied to the description of the Arctic grayling (*T. signifer*) as to the Michigan form (*T. tricolor*), as the annexed table may show:

SPECIFIC CHARACTERIZATIONS OF THE AMERICAN GRAYLINGS.

	<i>T. signifer.</i>	* <i>T. tricolor.</i>	<i>T. t. montanus.</i>
Head in length.....	5½	5	5
Depth in length.....	4½	5½ to 6	4½
Eye in head.....	3	3	3½
Maxillary in head.....	6	6	3
Scales.....	8-88 to 90-11	93-98	8-82 to 85-10
Gill rakers.....	12 below angle	21-22	5+12
Dorsal rays.....	24	21-22	18-21
Height of dorsal.....	3½ in length	Moderate	4½ in length
Spots on body.....	Anterior	Posterior	Anterior

* Not having the full description of *T. tricolor* at hand will account for the omission of some points in above table.

The color of the Montana grayling is as follows: back, gray, with purplish reflections; sides, lighter, with purplish and silvery reflections; belly, pure white; a few V-shaped spots from middle of dorsal fin to gill cover, but none posteriorly; two oblong black blotches in cleft between opercle and branchiostegals, more pronounced in the male; a dark heavy line on upper edge of belly, running from ventrals to pectorals in male, very faint in female.

Dorsal fin edged with a red or rosy border; six or seven rows of red or rosy, roundish spots, ocellated with white; dark blotches forming lines between the rows of red spots; in upper, posterior angle there are several larger oblong rosy spots. Ventral fins with three rose-colored stripes along the rays. Pectoral and anal fins plain.

DISCUSSION OF DR. HENSHALL'S PAPER.

Mr. Clark: In reference to the work Dr. Henshall is doing there, I wish to state that a case of these eggs was forwarded

this year to the station of which I have charge. They were billed to me as fifty thousand eggs. They came the forepart of June, probably the 10th, a very warm time, and they were nicely packed with an ice tray. The loss on these eggs was quite considerable, I should presume ten per cent. Some of them had hatched and died, but after they were thoroughly sorted out they measured up about sixty-seven thousand. They were said to be fifty thousand when they were sent. That is something remarkable, because fish culturists sometimes ship less than they count out on arrival at destination. I feel well assured that this is going to be a valuable work of the United States Fish Commission. I immediately wrote Washington after carrying them along until the time of distribution, and praised the work highly, and recommended that next year at least five hundred thousand be forwarded to the Northville station. Mr. Ravenel informs me that if the money is available they will send us all we want. The Montana grayling fry are very much different from the fry hatched from the eggs of Michigan grayling. They do not act the same in the troughs at all. After hatching, they settle on the bottom of the trough the same as trout fry. The fry hatched from the Michigan grayling about fifteen years ago at our station are free swimmers, the same as a white fish; but in the case of the Montana grayling they lie on the bottom of the trough from twenty-four to forty-eight hours before they begin to swim. Then they begin to swim, and of course the sac is absorbed in a very few days, about six or eight days; between the sixth and eighth day they begin to take food. We have them there now, and if you could take a look at them you would see them under different conditions from what you did those at the Omaha Exposition last year. So far they are doing very finely, very nicely indeed; but whether we are to succeed in raising many of them or not I can not say as yet. They are taking food. We are feeding them finely chopped liver.

President Peabody: Would you advise putting grayling in a stream where there are brook trout?

Mr. Clark: Well, you cannot hurt the brook trout any, but it is a question, of course about the grayling.

President Peabody: Whether you would waste your grayling or not?

Mr. Clark: Yes, whether you would waste your grayling or not. I have planted half of these in the Au Sable River and half in the Pere Marquette River, two old grayling streams, both having brook and rainbow trout now.

President Peabody: In regard to the temperature, a stream that is too warm for brook trout is all right for rainbow trout. How is it about the grayling?

Mr. Clark: We can keep them in ponds in the warmer water, if we have plenty of it. Mr. Stone informed me that Dr. Henshall, when he sent these on, advised that we be sure and hatch them in creek water, and keep them in creek water. We did not hatch them in creek water and we are not keeping them in creek water, because our creek water is not so clear and nice as our spring water. His idea was that we could not hatch them in our spring water.

Mr. Titcomb: As I understood it, the question was whether the grayling would survive in warmer water than our brook trout?

President Peabody: That is it.

Mr. Titcomb: I understand they require cold water. The cold, swift mountain streams of Montana are their natural habitat, and also some of the cold water lakes. These eggs Mr. Clark received came from the station, I presume, from which I received some, and were taken in what is called Red Rock Lake.

Secretary Whitaker: In answer to a question put by the President to Mr. Clark, I want to say that in my opinion there is no difficulty about grayling and trout living in harmony, at least such is disclosed to be the fact by the literature in England upon the subject from Francis and Walton down to the present day. There they are found in the same stream. So far as the temperature of the water is concerned I know nothing about it further than the character of the streams where they are found in Michigan. They are cold spring streams, and some of the best results obtained in trout culture in the United States have been had in old grayling streams. They do not inhabit streams south of a belt stretched some twenty or thirty miles north of Grand Rapids, diagonally northwest and southeast across the state. They are not indigenous to the streams below that line, so far as my knowledge goes.

President Peabody: They practically require the same water as brook trout.

Secretary Whitaker: Oh, yes.

Mr. Titcomb: May I inquire how you account for the disappearance of the grayling in your trout waters?

Secretary Whitaker: I have had occasion to refer to that in our reports three or four times, and there is no question that it is due to the lumbering operations in our state.

President Peabody: Are the trout similarly affected?

Secretary Whitaker: No; the spawning season of the grayling is later. During the winter the streams are filled with logs, and when the ice passes out in the spring, which is before the grayling eggs have hatched, they destroy the beds and kill the ova.

Mr. Parker: The spawning habits are entirely different. The trout spawns on the gravel and the grayling on the sandy ridges.

Secretary Whitaker As it is getting late, I move that the paper of Mr. Meehan be read by title.

The motion was seconded and carried.

OBSERVATIONS ON THE MORTALITY AMONG TROUT FRY AT THE ALLENTOWN HATCHING STA- TION THROUGH LONG INBREEDING.

BY W. E. MEEHAN.

On the twenty-fifth of February of the present year, the Pennsylvania Fish Commission had in its troughs at the eastern hatching station, near Allentown, 2,200,000 brook trout fry, 30,000 California trout fry, 8,000 brown trout fry, and 250,000 Atlantic salmon fry. Within two weeks thereafter the entire lot of little fish, except the Atlantic salmon, were all dead. To the superficial observer, the fry were in normal condition of health on the first of February, but to the practiced eye of the Superintendent all was not right with them from the time of hatching, although not alarming enough to make a formal report to me as the State Statistician of Fisheries.

When February was about half gone, the State was visited by a terrific blizzard, such as had not been experienced for many years. During it the far end of the lower hatching house was hove up about three and one-half inches by the frost. This caused the water in the hatching troughs to rise and back even to the farther troughs of the upper house. By the time this was discovered and the flow-cocks regulated, a thaw set in and the lower house sank back nearly to its original position, and disarranged the proper water supply again.

Almost immediately on the disarrangement of the water supply the disaster began. All the fry except the salmon, began to huddle at the upper end of the troughs about the inflow and to exhibit marked signs of distress. A week later the Atlantic salmon fry and about ten thousand wild trout showed some similar signs. In each trough were from twelve to fifteen thousand trout, and these crowded themselves in a space of a little more than a foot and a half square. Nothing could disperse them. A feather or the hand thrust among them would simply turn the little creatures over and over without resistance on their part. Within a few days they began dying at the rate of from one hundred thousand to over

two hundred thousand a day, and this continued until all the cultivated trout fry were dead. The wild trout fry subsequently died also, except about a thousand or two thousand. The Atlantic salmon recovered, none having died, and, when planted, were apparently fine, healthy fish.

As soon as the trouble began the Superintendent notified me and I began an investigation, and I soon became convinced that the trouble was caused primarily by a low vitality among the fry, due to too long continued inbreeding, and immediately to an insufficient amount of oxygen in the water on account of a vast amount of melted snow flowing in the spring, and to some extent by over-crowding in the nursery troughs.

It transpired that new blood had not been infused into the breeding stock for nearly seventeen years. This, it appears, was not altogether the fault of the Superintendent, because on at least two occasions he had made application for a change of blood, and about a year ago, shortly after my appointment as State Statistician of Fisheries, he had informed me of this fact and made application for wild eggs (which I secured him), and expressed his fears lest there would be trouble because he had not received the new blood previously asked for.

My investigation showed that the weather last fall was favorable to the hatching of all species of trout at the Allentown station. This was equally true as regards the water, although flowing from a gravel or disintegrated rock spring which has less aeration than one flowing from a limestone formation. The brook trout hatched in from forty to forty-two days, and appeared at first in a fairly satisfactory condition, except that they were under the normal size. The growth was then observed to be unusually slow, and they were fully fifty days in absorbing the sac. They were also very sluggish in their movements, which were only partially corrected by salt baths. Their sluggishness was also markedly noticeable during the feather washing. Instead of moving about in a lively manner when this was done, they would scarcely move at all, and, in fact, allowed themselves to be pushed about without resistance. Suddenly another change took place. The fry often became overactive, very excitable and wild, and showing great signs of fear. The little fish, perhaps sluggish and apathetic a moment before, would suddenly snap at anything floating in the water and seemed to be consumed with hunger, although they received an abundance of food. They even ate their own excrement, and this, instead of being of a healthy black color, was white, showing that the food given passed undigested through the stomach. The fish were also thin, as though half starved. The gills were whitened and apparently without blood.

It was not until the snow water began flowing into the spring and from thence into the troughs, that the fry began to huddle under the inflowing water and exhibit every sign of not having sufficient oxygen, but while, as an experiment, additional oxygen was supplied in some of the troughs by providing additional inflows and artificial aeration, the most that could be done was to break the huddling into as many groups as there were inflows. The artificial aeration seemed to have very little effect. Confinement in well aerated water outside the house was also tried without result.

The mortality began on February 26, on which day more than 50,000 died. Before March 1 over 350,000 were dead. In less than ten days thereafter there was not a single one of the entire hatching of eggs from the cultivated trout alive.

During the blizzard the wild trout fry showed evident signs of distress, but at no time to the same extent as the fry of the cultivated trout, namely, to huddle at one end of the trough. When they began to die, as they did at about the time the mortality of the others was past its height, it was with all the evidence of some well-defined disease, which attacked the gills, which disease I am inclined to believe was induced by the water being tainted by the other dying fish.

I am thoroughly satisfied that the original cause of the trouble at the Allentown station was due to too long-continued inbreeding, that the catastrophe was hastened by overcrowding the troughs and a sudden supply of unaerated water. Many premonitory things occurred during several preceding winters, for which other causes were assigned, but which afterward became cumulative evidence showing a steady lowering of vitality. For instance, the trout sent out from that station for five years back were abnormally small at the age of four months, very little larger, in fact, than the two months old fish hatched at the Corry or Western station. Moreover, there were more complaints during the previous three years of the number of dead fish from applicants than there were over the fish received from the Corry station. During the winter of 1897-98, more than half a million fry died at Allentown station. This mortality was ascribed at the time to the warm weather which caused the eggs to hatch in thirty days, producing weak fish, but which now we believe to have been but the precursor of the disaster which followed a year later.

The casualties at the Allentown station were so great and the matter was one of such widespread importance to fish culturists, that I felt that other judgment than mine should be given and other investigations be made. I therefore laid the matter before the United States Fish Commission when the trouble first openly manifested itself, and Commissioner Bow-

ers decided to send Dr. Charles M. Blackford of Washington, D. C., to study it. This gentleman, who is making a study of diseases of fish, remained at Allentown for nearly two weeks, and his findings coincided with mine as far as the question of inbreeding is concerned, but he did not appear to think the catastrophe was hastened by unsuitable water conditions, but Dr. Blackford was, and is probably yet, unaware of a fact which only came to my knowledge a number of weeks later, namely, that out of some thirty thousand fry of the winter's hatching distributed in retaining ponds in a different part of the state, more than one third did not die, the holders of these fry merely contenting themselves with complaining of an unusually bad lot of fish, of which the greater number died and the remainder were very small. These persons were entirely ignorant of the mortality at Allentown. Thus it will be seen that while all the fish remaining in the Allentown troughs died, a proportion of those given other environments escaped the same fate. This to my mind is conclusive evidence that there was some other immediate cause for the sudden loss of the fish than low vitality, due to persistent inbreeding.

Dr. Blackford's report is exceedingly interesting and was made in duplicate to me for the Pennsylvania Fish Commission and to the United States Commission.

Dr. Blackford says in part:

"During the winter of 1898-99 approximately two million brook trout were hatched in the Allentown station. The ova are hatched on beds of gravel and wire gauze trays. * * * The water is brought into the houses by an open trough that extends the entire length of the buildings and is pierced by cocks that allow a regulated amount of water to flow into the shallow troughs in which the eggs are hatched. This arrangement allows the water to become aerated and enables the dead or fungoid eggs to be readily fished out. After hatching, the fry are retained in the hatching troughs. These troughs are of wood. * * * At the lower end of each trough a screen of wire gauze extends across it from side to side, and between this screen and the end of the trough is the outlet. * * * The fish from which milt and ova are taken are reared in the hatchery and are the descendants of those brought to this station when it was removed from Marietta.

"In 1898 the fish began spawning very early, and spawn was taken on October 3. The period of incubation was short, only 35 to 42 days, and the fry are small.

"The troughs containing the fry were scrupulously clean, no algae or growths of any kind being found in them. The fry were huddled about the upper end, crowding so thickly around the inlet that they concealed the bottom, except the place on

which the jet of water fell. On touching the surface the fish seemed apathetic, not darting away as healthy fry usually do. Respiration was rapid and 'panting.' The fry took food languidly, though at times they snapped at it eagerly, but the food was not digested and the excreta was almost unchanged. The fish were very small. Although several months old, they were only about an inch long, and so weak that a slight increase in the flow of water would wash them away. They died in vast numbers; from 80,000 to 100,000 a day is not an overestimate.

"The fry are distinctly anaemic. They lack vitality and seem incapable of sustaining life. No fault of any kind can be found with the station or its management. On the contrary, the Pennsylvania Fish Commission is to be congratulated in its Superintendent. * * * The fault lies with the fish and not with the environment.

"So far as I am able to determine, there is no disease present. The gasping respiration is not accompanied with an inflammation of the gills and is due, in my opinion, to a lack of red blood corpuscles. A number of the fry were placed in a floating box with a wire gauze bottom and put in the race way that supplies the pond, in the hope that this water, which is better aerated than that in the house, might give relief, but no difference was observed.

"For fifteen years or more no new blood has been introduced, but steady inbreeding has been practiced. In some of the ponds are yearlings that appear to be healthy, but are small, and this small size may be due to a lack of fresh strain."

It might be noted that in Dr. Blackford's report he notes apparently what he regards as an unusual circumstance, namely, that the "fish began spawning very early, that spawn were taken on October 3." Apparently the Superintendent of the station failed to inform him that this is about the date on which the fish have for years been in the habit of beginning to spawn at this station, consequently this incident cannot be considered in studying the case. The trout at Allentown always spawn about a month earlier than at Corry, and it might not be uninteresting to note, although having nothing whatever to do with the subject, that while the California trout spawn in the Allentown ponds early in December, those in the Corry ponds in the western part of the state do not begin this function until March or April.

The loss of the entire hatching of trout fry at the Allentown station was a severe blow and a costly one as well, but it has taught us a lesson which we are not likely to forget in a hurry and which we are likely to profit by. From this out the blood in the Allentown ponds, and indeed in our other stations, will be changed every three or four years. As a last word, lest the

query might be raised, it might be stated that the fry in the Corry station are perfectly healthy and normal sized fish. The blood of the breeders has been changed twice within ten years.

Mr. Prather: Mr. President, I desire to say a word in relation to one stream of water which we have in the state of Kentucky, although it may not be found upon the map. A number of gentlemen, 125 in number, the membership is limited to that figure, have leased the water of this stream. They call the organization the Ellerslie Fishing Club. Therefore I shall style the body of water as Lake Ellerslie. It covers 136 acres, with surface drainage, two small streams and a great many small springs running into it. It has a maximum depth of 46 feet and an average in our main reservoir of over twenty feet. In the summer it is about 60 degree Fahrenheit. Numerous weeds grow in the water and furnish abundance of food for the fish. We have large mouth black bass and some time ago German carp were put in the smaller reservoir, and now they are to be found occasionally in the lower or larger reservoir. Now, we find our trouble to be largely in the size of the crappie. It remains just about three or four inches long. It is rarely ever the case we catch anything larger. Sometimes we catch a new-light or crappie two and a half pounds, but it is rarely the case. I want to find out something that would be good food for these fish.

Mr. Titcomb: Do you have the smelt?

Mr. Prather: What is that?

Mr. Titcomb: I cannot give you the scientific name. It is a small form of white fish. In some waters it never attains a length of more than five inches; in other waters it will attain a length of eight or ten inches; and we value them as a food fish also; but we introduce them in our New England waters. They are food for the salmonidae more particularly. They are in the lakes where we introduce the land-locked salmon. They increase very rapidly. They spawn by ascending the small tributaries to the lakes, and in summer they inhabit the deep waters of these lakes and furnish an abundance of food. In fact, the chief complaint we have had in New England, and I think all the New England states have encountered it, is that these smelt increase so fast that the game fish are satiated and do not take the lure of the angler so freely as they did before the smelt were introduced. The smelt can be introduced in the form of eggs. We have been more successful in introducing the fish themselves, where we can get them easily and transport them; but the fish spawn on bushes and shrubs

and leaves in the water, or on gravel, and can be taken out bodily on branches to which the eggs adhere, boxed up in lots and shipped and placed in any other stream where it is wished to introduce them. They then hatch out naturally and go on their way rejoicing. They will furnish food for your bass in time. At the same time there is a good deal of discussion about them.

Mr. Prather: Do you think it would do for us to have fresh water shrimp introduced as food?

Mr. Titcomb: You might be successful with them, and might not. In some places I have introduced them, and in other places I have been unsuccessful. I am unable to say to what waters they are best suited. I think the gentleman from Montana has described a lake where the smelt would thrive.

President Peabody: Alluding to carp, Mr. Ravenel stated to some of us last night that the carp had furnished food for the crappies and bass.

EXHIBITION OF MODEL OF FISH-LADDER, BY DR. J. C. PARKER, WITH REMARKS.

President Peabody: Dr. Parker has a matter which he wishes to bring before the convention, and has a model which he will show you with his explanation.

Mr. Parker: I will just say a word about the perennial question of fish-ladders, and that there are ladders and ladders. I will just show you the features of this invention. In this representation I intended to have a full working model, but failed to get it out for want of time. The idea is to have a trap made just as you would have a pound net, with a leading line leading up as I show you here. The construction of it is such that this would always be above the highest stage of water. My idea would be to have it all enclosed and the frame drop right down in so that it can be taken out at any time and cared for. You can use any power that is available. Of course, during the time of the running of the fish there would have to be an attendant, but until those things are tried the real practical side of it has yet to be determined. That is about all I have to say, and I just exhibit this to the Society. You are not limited as to the height. You can have it any height you desire. It is only a question of the length of chain you use. I think it can be made very cheaply so far as the question of expense is concerned. By the time another meeting is held I shall have one in active operation.

Secretary Whitaker: It strikes me that there is an advantage in that device over any other. You would not necessarily have to cut an opening in the dam?

Mr. Parker: Not at all.

Secretary Whitaker: That would overcome one of the most serious objections. It weakens a dam to put in these structures.

President Peabody: Have you succeeded in having any fish ways put in operation in your state?

Secretary Whitaker: Yes; we have had them for thirty years, but they are not successful.

Mr. Titcomb: I would like to ask the Doctor if he has taken into consideration the location of that pound net. These fish run, ordinarily, when the water is high and an ordinary pound net or almost any form of weir below the dam where you have to use the fish way, is going to be washed out.

Mr. Parker: I will give you my idea, that two or three feet high, diagonally across the stream, you put in something made of slabs and the force of the water will hold it there.

Mr. Titcomb: Does it not clog?

Mr. Parker: It does not matter about clogging. The water goes over it and the fish come under it. It can not clog on the under side.

Mr. Titcomb: Our dams have logs three or four feet in diameter going over them.

Mr. Parker: But this will not be over two or three feet high in the bottom of the river, and your flood wood, etc., during the time that your fish are running, would most generally be above the top of that. That is a practical thing which has been carried out in our river. They have put in booms in that way, and they are there today, little abutments like. It looks to me as if this would solve that very much vexed question of how to get the fish over the dams.

Secretary Whitaker: There is no reason why the State should not pass a law providing that in the construction of any new dam, whether it is an original, new construction or built to take the place of one swept away, the owner should be compelled to put in a chute. In the course of twenty years generally speaking, you would thus have chutes in a majority of the dams of the State. In the course of time dams grow weak, and they go out and have to be renewed, and in that way you could get his done where otherwise there would be too much opposition.

Mr. Titcomb: That is the way we are endeavoring to overcome the sawdust question in our State. That all new mills shall take care of their sawdust, and as the old ones are gradually retired, we will eventually get our streams purified.

Mr. Clark: I would like to say one word in regard to this fish way. In the early days of the Fish Commission I was at Holyoke, Mass., and one of my duties was to look at the fish-

way there and see if the shad ran up. Mr. Brackett, I think, the patentee of the fish-way, visited that station several times, and I told him that the shad did not go up the fish-way. There were plenty of shad at the mouth, but they did not ascend. He said, "If you will stand here with a net and catch those shad they will go up." I tried it and caught a few and put them in and they went up. Now, the Doctor has solved that problem for the shad, if it will do what he claims. The shad did come up to the foot of the fish-way, but would not enter it. The Doctor has something here that will force them to enter it.

Mr. Parker: Yes; if anything will solve the shad question, that or something similar to it will surely do so.

On motion duly seconded the Convention adjourned.

TREASURER'S REPORT.*

42 New York Street, N. Y., June 26, 1898.

To the American Fisheries Society:

Gentlemen—I herewith submit my annual report as Treasurer, from July 15, 1898, to June 26, 1899:

July 15, 1898, balance in hands of Treasurer.....	\$401 26
Receipts of.....1895, dues	\$1 00
“ “ 1896, “	3 00
“ “ 1897, “	9 00
“ “ 1898, “	120 00
	<hr/>
	133 00
	<hr/>
	\$534 26

DISBURSEMENTS.

1898, Stenographer's bill, (Voucher A).....	\$55 00
“ Postage to September 30.....	4 08
“ July printing, 250 Treasurer's receipts, (Voucher D).....	2 75
“ July printing, 250 envelopes, (Voucher C).....	1 50
“ October postage.....	1 06
“ November postage.....	1 16
“ November, Speaker Co. printing reports, (Voucher B).....	134 65
1899, January printing, 250 envelopes, (Voucher E).....	1 50
“ Typewriting.....	1 20
“ Disbursements by Secretary, as per his account, herewith attached as (Voucher F).....	32 62
“ June 20, 1899, postage from December, 1898.....	3 78
“ Discount on out town checks.....	40
	<hr/>
	239 70

June 26, 1899, balance in hand for 1898.....\$294 56

Yours respectfully,

L. D. HUNTINGTON,

Treasurer.

* (On account of sickness the Treasurer was unable to attend the meeting. His annual report was, however, forwarded by express to Secretary Whitaker at Niagara Falls, but was not delivered. Subsequently it was learned that the package containing the report and vouchers arrived in ample time for presentation at the meeting, but was mislaid through the carelessness of a hotel employé. Later the papers were returned to the Treasurer, who forwarded them to the present Secretary. President Titcomb then appointed Mr. Frank N. Clark as a Committee of Audit to examine the accounts. *Seymour Bower, Secretary.*

I hereby certify that I have examined the foregoing account, with accompanying receipts and vouchers, and find the same to be correct. I recommend that the report of the Treasurer be accepted and adopted.

(Signed) FRANK N. CLARK,
Committee of Audit.

SUPPLEMENTARY REPORT OF TREASURER.

I take the liberty of submitting briefly as supplementary to above annual report some subject matter that may be interesting to such members of the Society as may be present at the 28th annual meeting. It will be seen by the Treasurer's report that there is a reduction in the balance for the year of \$106.70; balance in treasury at time of last annual meeting being \$401.26, while present balance is \$294.56. This was caused by the reduction of yearly dues last year from \$3 to \$1. Unless the membership is greatly increased or the dues are raised again the treasury will soon become depleted. I have looked over the annual reports of the Treasurer from 1881 to date. I find at the commencement of the year 1881 there was a deficit of \$131.70 in the treasury. The total receipts from 1881 to date (19 years) were \$4,957, while the disbursements for the same period were \$4,530. Add to the disbursements the deficit of \$131.70 (due to balance the treasury) makes the total disbursements equal, \$4,661.70—leaving a balance of \$295.30, which virtually represents the present balance in the treasury. During this period the yearly average membership was 167, the least number of members being 121 for year 1884; the highest, 250 for year 1894; the annual dues during the period being \$3, except for the year 1898, when it was \$1; the yearly average receipts being \$260.88; the disbursements \$245.35, being a yearly average of \$15.53, excess of receipts over disbursements. There are now on the list of members revised for use of the Secretary for the coming report (of 1899), 160; members with dues paid in full to date, 120; members owing one year's dues, 15; members owing two years' dues, 12; members owing three or more years' dues and liable to be dropped from the list under article two of the constitution for non-payment of dues, 13. Have dropped no names from the list for non-payment of dues this year, hoping to be able to collect the dues of some of them. While some of the thirteen have taken no notice of the four requests made of them the past year, others have made promises to pay soon as they could. There was a membership of 136 as revised and reported to the Secretary last year. The Secretary has reported to me the names of 28 new members for the year 1898, one of whom, Mr. J. E. McLeod, of Milwaukee, I have been unable to find; therefore his name does

not appear as a member. The Society has lost three members during the year; two, Mr. T. W. B. Hughes, of New York City, and Samuel Wilmot, of New Castle, Ontario, by death, and one, Mr. E. G. Whitaker, of New York, by resignation, whose resignation should be accepted by this meeting, leaving present membership at 160.

Respectfully submitted,
L. D. HUNTINGTON,
Treasurer.

CONSTITUTION.

(As amended to date.)

ARTICLE I.

NAME AND OBJECTS.

The name of this Society shall be American Fisheries Society. Its objects shall be to promote the cause of fish-culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all the interests of fish-culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of one dollar, become a member of this Society. In case members do not pay their fees, which shall be one dollar per year, after the first year and are delinquent for two years, they shall be notified by the Treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice President, who shall be ineligible for election to the same office until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which, with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting or, in default of such action, by the Executive Committee.

ARTICLE V.

CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said meeting.

LIST OF MEMBERS.

ACTIVE.

- '92. Adams, E. W., 114 Wall st., New York.
'93. Alexander, L. D., 50 Broadway, New York.
'98. Alexander, G. L., Grayling, Mich.
'92. Anderson, J. F., 240 Eleventh st., Jersey City, N. J.
*Annin, James, Jr., Caledonia, N. Y.
'84. Atkins, Chas. G., East Orland, Me.
'92. Ayer, F. W., Bangor, Me.
'98. Babbitt, A. C., Williamsburg, Mich.
'98. Ball, E. M., Leadville, Col.
'91. Babcock, C. H., Rochester, N. Y.
'98. Barrett, W. W., Church's Ferry, N. D.
'86. Bartlett, Dr. S. P., Quincy, Ill.
'97. Bell, Currie G., Bayfield, Wis.
*Belmont, Hon. Perry, 19 Nassau st., New York.
*Benkard, James, Union Club, New York.
'99. Benton, W. H., Bullockville, Ga.
'84. Bickmore, Prof. A. S., Am. Museum Natural History,
New York.
'97. Birge, Prof. F. A., Madison, Wis.
'86. Bissell, John H., Detroit, Mich.
'86. Booth, A., cor. Lake and State sts., Chicago, Ill.
'90. Bower, Seymour, Detroit, Mich.
'99. Bowers, Hon. George M., U. S. Comm'r of Fisheries,
Washington, D. C.
'92. Bowman, W. H., Rochester, N. Y.
*Bottemanne, C. J., Bergen op Zoom, Holland.
'99. Brewer, W. C., Cleveland, O.
'92. Bradley, Dr. E., 19 West Thirtieth st., New York.
'98. Brown, George M., Saginaw, Mich.
'92. Brush, Dr. E. F., Mount Vernon, N. Y.
'97. Bryant, E. E., Madison, Wis.
'97. Bulkley, H. S., Odessa, N. Y.
'98. Bumpus, Prof. H. C., Providence, R. I.
'84. Cary, Dr. H. H., Lagrange, Ga.

*Admitted to membership prior to 1881.

- '84. Cheney, A. N., Glens Falls, N. Y.
'84. Clark, Frank N., Northville, Mich.
'81. Crook, Abel, 99 Nassau st., New York.
*Crosby, H. F., 30 Broad Street, New York.
'99. Curtis, J. M., Cleveland, O.
'95. Dale, J. A., York, Pa.
'95. Davis, Palmyra, N. Y.
'97. Davis, George B., Utica, Mich.
'93. Davis, Horace W., Grand Rapids, Mich.
'94. Demuth, H. C., 144 E. King st., Lancaster, Pa.
'96. Dickerson, F. B., Detroit, Mich.
'99. Dinsmore, J. H., St. Johnsbury, Vt.
'94. Douredoure, B. L., 103 Walnut st., Philadelphia, Pa.
'99. Downing, S. W., Stone, Oregon.
'89. Doyle, E. P., Port Richmond, N. Y.
'94. Ebel, Hon. F. W., Harrisburg, Pa.
'85. Ellis, J. F., U. S. Fish Commission, Washington, D. C.
'96. Emerick, H. F., San Francisco, Cal.
'97. Fox, J. C., Put-in-Bay, O.
'99. Filkins, B. G., Northville, Mich.
'89. Friesmuth, E. H., Jr., 151 North Third st., Philadelphia, Pa.
'95. Frothingham, H. P., Mount Arlington, N. J.
'92. Gavitt, W. S., Lyons, N. Y.
'99. George, Hon. A. F., Swanton, Md.
'98. Griffith, S. L., Danby, Vt.
'90. Gunckel, J. E., Toledo, O.
'89. Hagert, Edwin, 32 North Sixth st., Philadelphia, Pa.
*Haley, Caleb, Fulton Market, New York.
'92. Hamilton, Robert, Greenwich, N. Y.
'95. Hansen, G., Osceola Mills, Wis.
*Harris, J. N., Fulton Market, New York.
'89. Hartley, R. M., 627 Walnut st., Philadelphia, Pa.
'84. Henshall, Dr. J. A., Bozeman, Montana.
*Hessell, Dr. Rudolph, 1209 Eighth st., Washington, D. C.
'96. Hill, John L., 115 Broadway, New York.
'95. Holden, H. S., Syracuse, N. Y.
'92. Hoxie, J. W., Carolina, R. I.
'97. Hunsaker, W. J., Detroit, Mich.
'91. Huntington, L. D., New Rochelle, N. Y.
'95. Hurlbut, H. F., East Freetown, Mass.
'84. Hutchinson, E. S., Washington, D. C.
'99. Hughes, Frank L., Ashland, N. H.
'89. James, Dr. B. H., n. e. cor. Eighteenth and Green sts., Philadelphia, Pa.
'95. Jennings, G. E., Fishing Gazette, 203 Broadway, N. Y.

*Admitted to membership prior to 881.

- '93. Jones, Alexander, Erwin, Tenn.
*Johnson, S. M., Union Wharf, Boston, Mass.
- '95. Jones, Dr. O. L., West 72d st., New York.
- '85. Kauffman, S. H., Evening Star, Washington, D. C.
*Kelly, P., 346 Sixth ave., New York.
- '99. Kerr, T. R., Pittsburg, Pa.
- '99. Kiel, W. M., Carolina, R. I.
- '96. Kilburn, F. D., Albany, N. Y.
- '98. Leach, G. C., 3923 Finney ave., St. Louis, Mo.
- '98. Lydell, Dwight, Mill Creek, Mich.
- '84. McGown, Hon. H. P., 108 Fulton st., New York.
*Mallory, Chas., Burling Slip, New York.
- '99. Mancha, H. H., Northville, Mich.
- '95. Manning, W. W., Marquette, Mich.
- '82. Mansfield, H. B., Lieut-Com. U. S. Navy, St. Louis, Mo.
- '97. Manton, Dr. W. P., Detroit, Mich.
- '98. Marks, H. H., Sault Ste. Marie, Mich.
- '98. Marks, J. P., Paris, Mich.
- '99. Marsh, M. C., Washington, D. C.
- '84. May, W. L., Omaha, Neb.
- '94. Meehan, W. E., Public Ledger, Philadelphia, Pa.
- '92. Merrill, F. H. J., State Museum, Albany, N. Y.
- '84. Milbank, S. M., Union Club, New York.
- '99. Merrill, M. E., St. Johnsbury, Vt.
- '99. Miller, G. F., Put-in-Bay, O.
- '99. Miller, W. S., Gallion, O.
- '92. Mills, G. T., Carson City, Neb.
- '99. Moore, C. H., Detroit, Mich.
- '98. Morgan, H. A., Baton Rouge, La.
- '92. Morrell, Daniel, Hartford, Conn.
- '99. Morse, Grant M., Portland, Mich.
- '99. Morton, W. P., Providence, R. I.
- '96. Mosher, Stafford, Fort Plain, N. Y.
- '96. Murdock, W. C., San Francisco, Cal.
- '99. Mussey, George D., Detroit, Mich.
- '96. Nash, Dr. S. M., 63 West 49th st., New York.
- '98. Oberfelder, R. S., Sidney, Neb.
- '97. O'Brien, W. J., South Bend, Neb.
- '95. O'Hage, Dr. Justus, St. Paul, Minn.
- '97. Osborn, Wm., Duluth, Minn.
- '99. Orr, W. J., Bay Port, Mich.
- '95. Page, P. W., West Summit, N. J.
- '84. Parker, Dr. J. C., Grand Rapids, Mich.
- '95. Peabody, G. A., Appleton, Wis.
- '91. Post, Hoyt, Detroit, Mich.
- '88. Powell, W. L., Harrisburg, Pa.

*Admitted to membership prior to 1881.

- '92. Powers, J. A., Lansingburg, N. Y.
'98. Powers, J. W., Paris, Mich.
'92. Preston, Dr. G. H., 98 Lafayette Square, Brooklyn, N. Y.
'97. Preston, John L., Columbiaville, Mich.
'99. Prather, J. Hub, Lexington, Ky.
'89. Rathbun, Richard, Smithsonian Institution, Washington, D. C.
'96. Rathbone, Wm. F., D. & H. R. R., Albany, N. Y.
'93. Ravenel, W. de C., U. S. Fish Commission, Washington, D. C.
'98. Reighard, Prof. J. E., Ann Arbor, Mich.
*Ricardo, George, Hackensack, N. J.
'98. Richards, G. H., Boston, Mass.
'99. Roberts, A. D., Woonsocket, R. I.
'99. Robinson, W. E., Mackinaw City, Mich.
'98. Rogers, J. M., Chicago, Ill.
'99. Root, Henry T., Providence, R. I.
'98. Rosenberg, Albert, Kalamazoo, Mich.
'95. Rowinville, E. T., East Freetown, Mass.
'98. Ruge, John G., Apalachicola, Fla.
'97. Russell, Henry, Detroit, Mich.
'81. Schaffer, Geo. H., foot Beekman st., New York.
'92. Sherwin, H. A., 100 Canal st., Cleveland, O.
'99. Smith, L. H., Algona, Iowa.
'87. Spenceley, Calvin, Mineral Point, Wis.
'96. Steers, E. P., 2076 5th ave., New York.
'70. Stone, Livingston, Cape Vincent, N. Y.
'99. Southwick, J. M. K., Newport, R. I.
'99. Starbuck, Alexander, Cincinnati, O.
'98. Stelle, G. F., Chicago, Ill.
'99. Sterling, J. E., Crestfield, Md.
'99. Stewart, A. T., Northville, Mich.
'98. Stranahan, F. A., Cleveland, O.
'98. Stranahan, F. F., Cleveland, O.
'98. Stranahan, H. B., Cleveland, O.
'90. Stranahan, J. J., Put-in-Bay, O.
'89. Streuber, L., Erie, Pa.
'97. Sykes, Henry, Bayfield, Wis.
'99. Tawes, J. C., Crestfield, Md.
'99. Thayer, W. W., Detroit, Mich.
'97. Thompson, Carl G., 78 Henry st., Huntington, Ind.
'92. Titcomb, John W., St. Johnsbury, Vt.
'99. Tubbs, F. H., Neosho, Mo.
'98. Tulian, Eugene A., Leadville, Colo.
'92. Van Cleef, J. S., Poughkeepsie, N. Y.
'96. Walker, Bryant, Detroit, Mich.

*Admitted to membership prior to 1881.

- '99. Walleth, W. H., Put-in-Bay, O.
- '96. Walters, C. H., Cold Spring Harbor, N. Y.
- '89. Walton, C. H., 1713 Spring Garden st., Philadelphia, Pa.
- '98. Ward, Prof. H. B., Lincoln, Neb.
- '92. Webb, W. Seward, 44th st. and Vanderbilt ave., N. Y.
- '95. Weed, W. R., Potsdam, N. Y.
- '86. Whitaker, Herschel, Detroit, Mich.
- '96. White, R. Tyson, 320 Bridge st., Brooklyn, N. Y.
- '89. Wilbur, H. O., 235 3d st., Philadelphia, Pa.
- '99. Willard, C. W., Westerly, R. I.
*Willetts, J. C., 40 Wall st., New York.
- '99. Williams, J. A., St. Johnsbury, Vt.
- '99. Wilson, S. H., Cleveland, O.
- '99. Wires, S. P., Duluth, Minn.
- '92. Wetherbee, W. C., Port Henry, N. Y.
- '97. Wood, C. C., Plymouth, Mass.
- '99. Zalsman, Philip G., Paris, Mich.
- '92. Zweighalt, S., 104 West 71st st., New York.

*Admitted to membership prior to 1881.

PROSPECTIVE MEMBERSHIP.

Applications for membership, with remittance of regular membership fee, have been received as below since the annual meeting at Niagara Falls:

Adams, Fred J., Grand Rapids, Mich.
Ainsworth, C. E., Sault Ste Marie, Mich.
American Fish Culture Co., Carolina, R. I.
Boyce, Frederick C., Carson City, Nevada.
Bullard, C. G., Kalamazoo, Mich.
Chambers, Arthur E., Kalamazoo, Mich.
Dunlap, Irving H., U. S. Fish Com., Washington, D. C.
Green, Myron, Franklin, Vt.
Hubbard, Waldo F., Nashau, N. H.
Jensen, Peter, Escanaba, Mich.
Lambkin, J. Bayard, Cape Vincent, N. Y.
Locke, E. F., Wood's Hole, Mass.
Mead, A. D., Brown University, Providence, R. I.
Seagle, Geo. A., Wytheville, Va.
Smith, Dr. Hugh M., U. S. Fish Com., Washington, D. C.
Starr, Wm. J., Eau Claire, Wis.
Thompson, W. T., Nashau, N. H.
Tucker, Edmund St. George, Halifax, N. S.
Vincent, W. S., Leadville, Colo.
Vogelsang, Alexander T., Mills Building, San Francisco, Cal.

The active and prospective membership lists as revised and brought down to October 15, 1899, include 204 names.

HONORARY.

The President of the United States.
The Governors of the several States.
Borodine, Nicholas, Delegate of the Russian Association of Pisciculture and Fisheries, Uralsk, Russia.
Mather, Fred, Lake Nebagomoin, Wis.
Southside Sportsmen's Club, Oakdale, L. I., N. Y.
New York Association for the Protection of Fish and Game, New York City.

Lake St. Clair Shooting & Fishing Club, Detroit, Mich.
Woodmont Rod and Gun Club, Washington, D. C.
Fish Protective Association of Eastern Pennsylvania, 1020
Arch st., Philadelphia, Pa.

CORRESPONDING.

Apostolides, Prof. Nicolý Chr., Athens, Greece.
Armistead, J. J., Dumfries, Scotland.
Benecke, Prof. B., Commissioner of Fisheries, Königsberg,
Germany.
Birbeck, Edward, Esq., M. P., London, England.
Brady, Thos. F., Esq., Inspector of Fisheries, Dublin Castle,
Dublin, Ireland.
Feddersen, Arthur, Viborg, Denmark.
Giglioli, Prof. H. H., Florence, Italy.
Ito, K., Member of Fisheries Department of Hokkaido and
President of the Fisheries Society of Northern Japan,
Sapporo, Japan.
Jaffa, S., Osnabruck, Germany.
Juel, Capt. N., R. N., President of the Society for the Develop-
ment of Norwegian Fisheries, Bergen, Norway.
Landmark, A., Inspector of Norwegian Fresh Water Fisheries,
Bergen, Norway.
Lundberg, Dr. Rudolph, Inspector of Fisheries, Stockholm,
Sweden.
Maccleay, William, President of the Fisheries Commission of
New South Wales, Sydney, N. S. W.
Maitland, Sir James Ramsay Gibson, Bart., Howieton, Stirling,
Scotland.
Malmgren, Prof. A. J., Helsingfors, Finland.
Marston, R. B., Esq., Editor of the Fishing Gazette, London,
England.
Olsen, O. T., Grimsby, England.
Sars, Prof. G. O., Government Inspector of Fisheries, Chris-
tiania, Norway.
Senior, William, London, England.
Smitt, Prof. F. A., Stockholm, Sweden.
Sola, Don Francisco Garcia, Secretary of the Spanish Fisheries
Society, Madrid, Spain.
Solsky, Baron N. de, Director of the Imperial Agricultural
Museum, St. Petersburg, Russia.
Trybom, Dr. Filip, Stockholm, Sweden.
Walpole, Hon. Spencer, Governor of the Isle of Man.
Wattel, M. Raveret Secretary of the Societe d'Acclimatation,
Paris, France.
Young, Archibald, Esq., Inspector of Salmon Fisheries, Edin-
burgh, Scotland.